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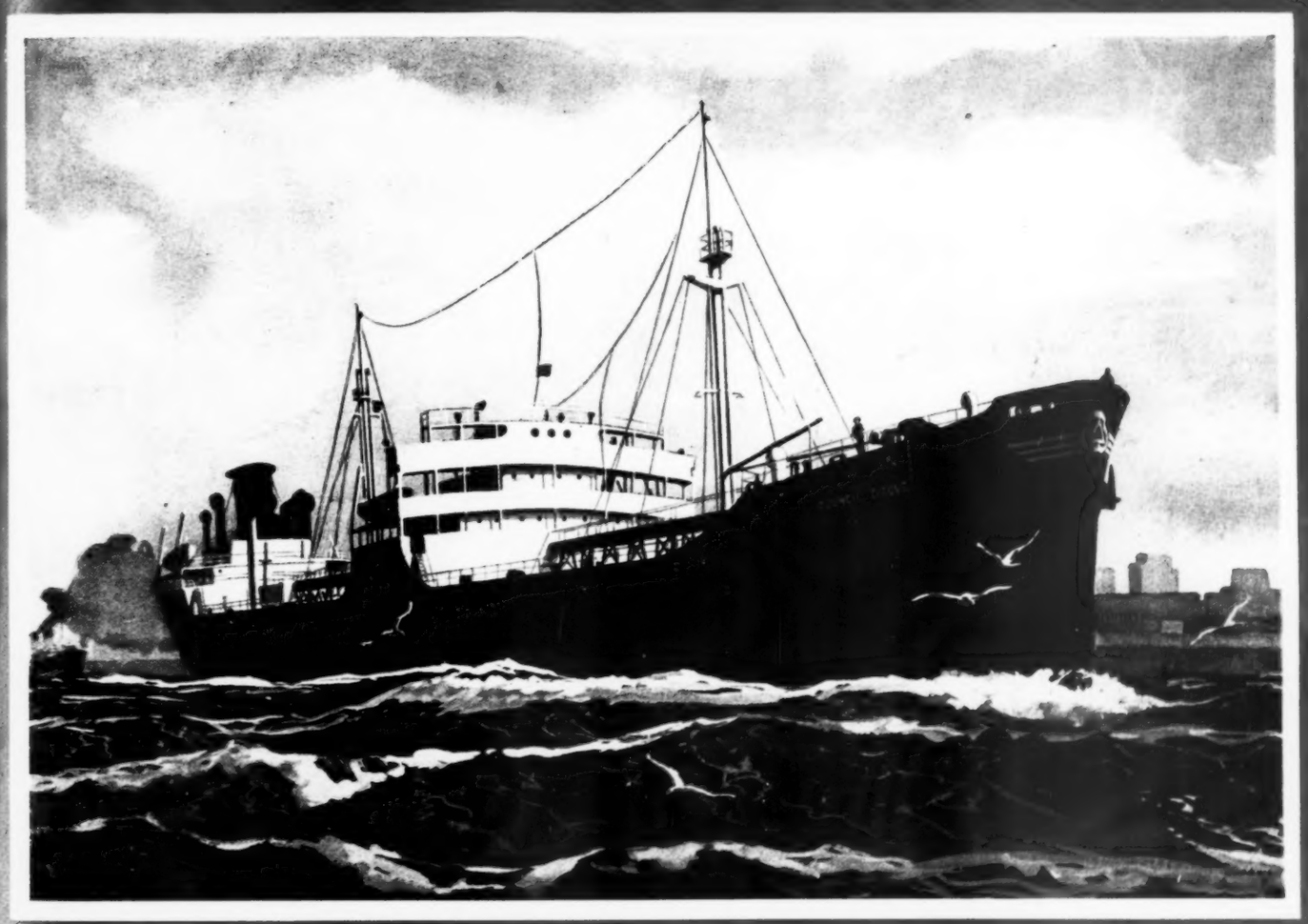
WORLD PETROLEUM



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SILVER ANNIVERSARY 25 1923 YEAR 1947

WORLD PETROLEUM

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This Month's Cover

The tank steamer Council Grove is a T-2 type ship launched in 1945 and now owned by Cities Service Oil Co. The Council Grove has a cargo capacity of 138,335 barrels and a deadweight tonnage of 16,765. With turbo-electric drive she has an average speed of 14.6 knots when loaded. The Cities Service fleet of tankers now consists of 7 newly acquired vessels with a total dead weight tonnage of 114,400. Most of the ships are engaged in coastwise service between the company's refinery at Lake Charles, La., and Cities Service terminals on the Atlantic Coast. Color plates of the painting are published through the courtesy of the editors of SERVICE, company magazine. The Council Grove was painted by Rockwell Brank of California. During the war Mr. Brank was in the Army camouflage division in Europe. He spent his spare time painting harbors, ships and seascapes and now specializes in marine painting.

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Date	CHARGE TO TCC PLANT CONTAINED:			
	Full Crude	*Reduced Crude*	*Virgin Gas Oil*	*Kerosene*
June 7	—	—	100%	—
8	—	—	75%	25%
9	—	—	—	100%
10	25%	50%	25%	—
11	70%	—	30%	—
12	50%	—	30%	20%
13	50%	30%	—	20%
14	50%	50%	—	—

Only a Houdry-licensed catalytic cracking unit could possibly accommodate such frequent changes of charge stock without shutdown and consequent considerable (and costly) loss of production. In the case of the TCC unit reported above, no major reduction in throughput, or in output of catalytic gasoline, resulted from the daily and drastic variations in feed charge.

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EDITORIAL

INTERNATIONAL OIL CONTROL A FALLACY

APPLICATION of the International Cooperative Association to the Economic and Social Council of the United Nations asking that body to interest itself in Middle East oil brings into the foreground once again an issue that has been hovering over the international scene for the past three years. While the resolution submitted asked only for a study of national rivalries in the world oil market, it is well understood that it was intended to be preliminary to a movement for setting up an international authority to supervise the world's oil trade, or, failing that, to make the distribution of Mideastern oil a special charge of the United Nations. Though the Council wisely declined to undertake the suggested study on the ground that it would be impractical and unrealistic, it is not to be expected that this will dispose of the matter. It is certain to crop up whenever its supporters see an opportunity to gain a hearing.

When the Anglo-American oil treaty was originally drawn, it was admittedly regarded as a step toward the establishment of a convention to deal with international trade in oil. In fact its signers pleged themselves to call a conference of all interested nations, both producers and consumers, to determine exactly the scope and functions of such commission or agency as might be established. It was this feature of the plan that aroused tremendous opposition among American oil producers, who felt that they could detect in it the thin blade of an entering wedge that might lead to ultimate dictation over their own operations. This opposition resulted in the modification of the treaty to include specific disavowal of any purpose to interfere in the internal oil economy of any nation.

Even with these assurances, lingering suspicions have remained that some form of international regulation of oil is looked upon with favor in certain official quarters. This suspicion has been strengthened by various acts and utterances of representatives of the State Department of the United States, and the attempt to interest the United Nations is looked upon merely as an approach from a different direction.

An argument put forward in support of international control of oil is that it would end the rivalry of interests that otherwise might endanger the peace of the world. Unfortunately the record to date, including that of the United Nations, indicates that the attempted direction of a commercial operation by what is necessarily a political body, far from eliminating causes of conflict, would accentuate national rivalries and introduce factors stifling to all progress.

On the other hand the development of oil resources under private management affords the surest means of escaping the dangers that the advocates of international control seek to forestall. Companies that engage in the highly hazardous oil business are actuated frankly by a profit motive. They invest very large sums in exploration, occasionally with highly successful results and more frequently without return commensurate with the effort and expenditure. They are anxious to produce oil in whatever quantity the market can absorb within limitations that will avoid too rapid depletion of their fields. They distribute their products wherever a demand for these exists or can be created. Since their business is conducted strictly upon a demand and supply basis they have no incentive to withhold their wares from any nation that has use for them. Active competition keeps prices at reasonable levels. Such competition prevails in all parts of the world except where it is prevented by governmental action for the protection of government-sheltered monopolies.

There has been much talk of have and have-not nations, but upon analysis this is found to be based upon theoretical rather than practical considerations. It is true, to be sure, that some countries are more richly endowed than others with indigenous deposits of petroleum, but insofar as supplies of products are concerned, the have-not nations are those that are not in position to make extensive use of such products. To raise their consuming power is a matter of broader industrial development and changes in habits of life which can be brought about only gradually through a change in the national economy, in education and living standards.

The marvellous progress of the oil industry has been accomplished through private enterprise and the willingness of individuals to assume great risks in the hope of great rewards. More than almost any other line of endeavor, the oil business thrives best when left to private endeavor. The qualities it requires are those in which governments are conspicuously deficient, and the places where its development has been slow and inefficient are those where governments have insisted upon its management directly or through some closely controlled agency. The time may come when all human affairs may be effectively directed through a parliament of the world, but it certainly is not yet within sight.

VENEZUELAN GOVERNMENT DEFINES ITS OIL POLICY

By Ruth Sheldon

Ruth Sheldon, author of the following article, first went to Venezuela in 1941 as Petroleum Specialist for Petroleum Administrator Ickes on a survey of oil fields and refineries in South America. In 1943 she returned to Venezuela at the request of the Venezuelan government in connection with the new Venezuelan petroleum law. She has made several trips annually to Venezuela since then, and her analyses of oil events as well as various aspects of the international oil situation have appeared in WORLD PETROLEUM, *Saturday Evening Post*, *Collier's* and other magazines. The accompanying article is an exposition of the policy and objectives of the Venezuelan government given exclusively to this magazine.

THE economic center of gravity of world oil may be shifting from the Caribbean to the Middle East, but the political factors involving American development of foreign oil are more reassuring and stable in Venezuela than anywhere else in the world today.

This is of extreme importance and significance. It is important because (1) The United States is now for the first time a net oil importing country; (2) Venezuela, world's second largest producing country, is the only strategic source of United States supply in case of another world conflict; (3) Petroleum ranks second in total United States foreign industrial investment; and (4) 19½ percent of the entire world investment of the United States is in Venezuela, which represents more than three times the oil investment in the Middle East. It is significant because (1) Since 1943 Venezuela has moved more rapidly than any other country toward a practical answer to the social-and-economic-dynamite-laden question, "What is an equitable division of profit between the exploiting companies and the nation owning the resources?" (2) The Venezuelan 1945 revolution brought into power the most advanced liberal political group in South America; (3) Venezuela's entire economy depends upon oil, making the industry an extreme test tube case; and (4) Venezuelan government oil policy has a decided influence on other Latin American oil policies.

The reassuring political factors concerning Venezuelan oil are well analyzed in an exclusive statement to WORLD PETROLEUM by Dr. Juan Pablo Perez Alfonzo, Venezuelan Minister of Fomento, which statement will be quoted from at length throughout this article.

Dr. Perez Alfonzo, in the two years during which he has held his Cabinet post, has proved to be one of the most able, aggressive and outstanding oil ministers in Latin American oil history. Young, brilliant, a law professor and economist, he has been President Romulo Betancourt's mainstay in government efforts to solve Venezuelan economic problems as a whole. Neither President Betancourt nor Dr. Perez Alfonzo views oil as separate from the nation's other problems, which has been the Venezuelan government tendency in the past. They think and act on oil in relation to the entire national economy. In addition, under Dr. Perez Alfonzo's guidance, Venezuela is developing a sound foreign oil policy to coordinate with its general domestic program.

"The condition of the oil companies in Venezuela is stronger than ever," Dr. Perez Alfonzo states, "because while satisfying the aspirations of the Venezuelan state for a just relation of interests, at the same time it has been successfully proved that mutual understanding guarantees better than anything else the future development of the petroleum industry in Venezuela."

How are the aspirations of the Venezuelan state for a just relation of interests being satisfied? During 1946 the Venezuelan government oil income from all tax sources was approximately equal to the net profit shown by the oil companies. "With this 50-50 arrangement," Dr. Perez Alfonzo points out, "the people feel themselves associated with the industry, and instead of having opposing interests, those of the nation and those of the industry are parallel."

This new feeling of partnership has not been come by easily, nor does it mean that there are not extremists among Venezuelan political groups and in the oil industry who assert that mutual understanding and parallel interests have not been attained. Neither does it exclude the probability that the "partnership" will have to solve many a controversial issue in the future.

The Barranca, first ship to tie up at the newly completed pier at the Shell refinery at Punta Cardon.

However, the fact that a nation and the foreign oil companies developing its resources are thinking and acting on a partnership basis is a far cry from the Mexican oil expropriation of 1938.

A severe test of this partnership could possibly arise within a few years over competition between Middle Eastern and Venezuelan crudes in the world markets. Costs of Venezuela's advanced labor legislation and its oil taxes equaling company net profits do not leave a wide margin per barrel for competition with Middle East oil, where taxes and labor costs are much lower and where the average single oil well produces 25 times as much as the average Venezuelan well.

A question of absorbing economic importance to the American oil companies in Venezuela is what Venezuelan government policy would be as a partner in meeting that competition if it comes.

Dr. Perez Alfonzo makes it exceedingly clear that the Venezuelan government cannot foresee in the immediate future any strong world market competition and believes that new Middle Eastern production will simply be enough to satisfy increased world consumption needs. "Notwithstanding that the known facts do not justify any worry whatsoever," he says, "it is always possible that unforeseen circumstances may produce economic depressions. In that event, Venezuela will know how to react in the most effective manner to solve the difficulties which may arise.

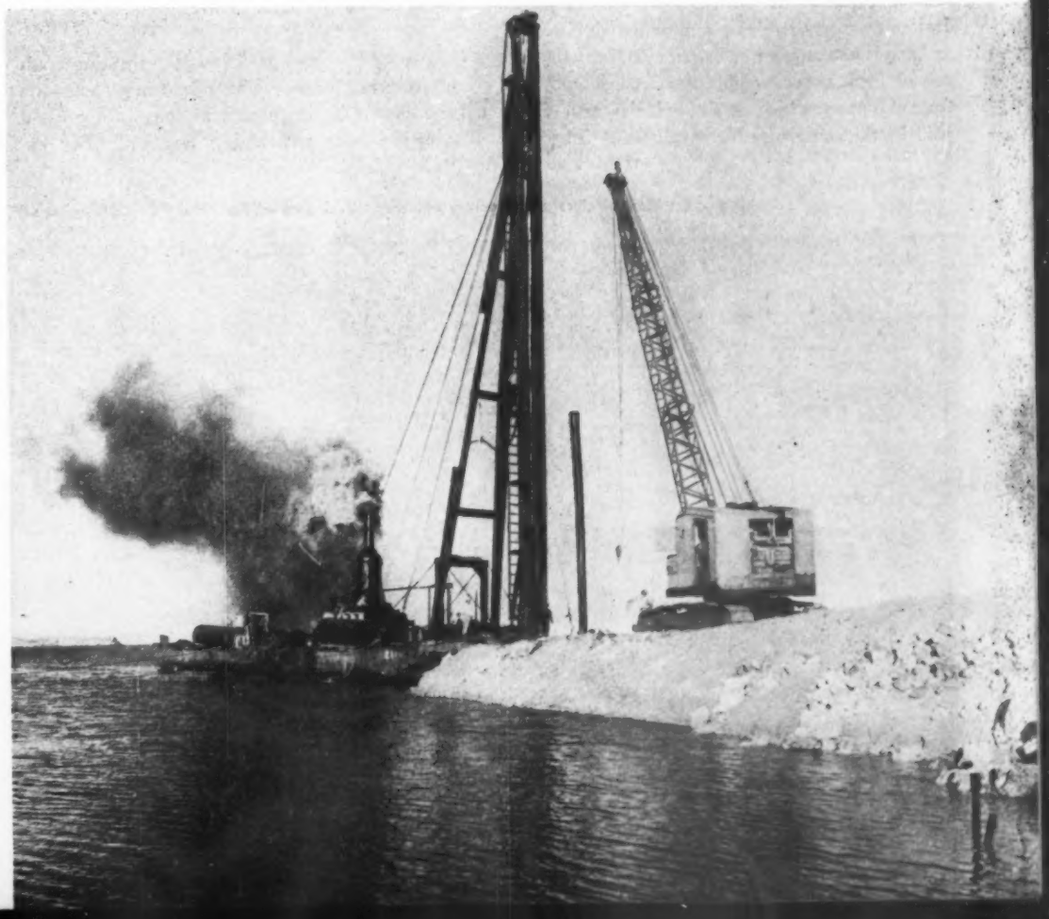
"Venezuela will know how to accept the consequences of a reduction in production, if and when the decrease of prices reaches the point where the share which it receives does not represent an adequate compensation, in the same way as Venezuela has known how to demand and obtain an equitable participation in the exploitation of its sub-soil wealth, and does everything necessary to make the most effective use of this great income. In other cases Venezuela will know how to adjust this participation to back up the efforts which may be necessary to conserve its international markets."

The means by which the Venezuelan government has demanded and obtained a longer participation in oil exploitation has been through two-fold-increased royalty and increased taxes.

In 1943 under General Isaias Medina's regime, a new oil law was enacted which provided for 16⅔ percent royalty for the government, representing an increase of 70 percent in government oil revenue. President Betancourt, then leader of the opposition Democratic Action party, and Dr. Perez Alfonzo, then a Democratic Action Congressional Deputy, opposed the new law on the grounds that, while it provided for a decrease in government royalty if a property could not operate economically under the royalty burden, it did not provide for the counterpart of that concept—that in times of extraordinary profit, the government would share proportionately.

Dr. Perez Alfonzo, Minister of Fomento, Venezuela

Driving piles for bulkhead at end of temporary barge dock (beachhead type) at site of Amuay Bay refinery of Creole Petroleum Corp.



When the October, 1945, revolution placed the Democratic Action party in power pending a new constitution and popular elections, the world oil situation had proved President Betancourt's and Dr. Perez Alfonzo's point. Increased demand and high market prices had given the oil companies profits on their 5/6th of the oil that greatly exceeded the government's increase in profit on its 1/6th. The new administration promptly reacted to the situation with an extraordinary income tax on all 1945 profits, amounting to 20 percent above the normal 12 percent levy in the case of the oil companies. This produced an additional $30,000,000 of government oil revenue. At the end of 1946 a permanent maximum rate of 28½ percent excess profits tax, wtih certain discounts for reinvestment of capital was approved. Under this enactment the government continues to obtain what it considers to be its fair share of the current high crude market prices as applied to all Venezuelan oil.

Government oil income has also skyrocketed as a result of the rapid increase in production. Production in 1946 was 388 million barrels, double that of 1938. Dr. Perez Alfonzo points out that an interesting comparison in the increase in government petroleum revenue from royalty and taxes is to take the 1938 income of Bs112,755,711 ($33,860,000) as an index base of 100. On this basis 1939 and 1940 would be 92 and 82 respectively; 1941 and 1942, 102 and 64, while in 1946 with an income of Bs492,342,149 ($147,800,000) the index is 437.

The government contemplates receiving additional benefits from sale of its royalty oil to others than the concessionary companies who have taken practically all of it in the past. It has already sold a shipment of some 58,000 barrels to an Italian company receiving approximately 10 cents a barrel bonus over what it would have received from the oil companies according to the formula upon which is figured the cash value paid by the companies for royalty oil. The government has announced its willingness to sell up to 25 percent of its royalty oil, and bids were invited for submission by the latter part of August for consideration. Various European and South American governments have expressed interest in such purchases.

At the present time, however, the government is not overanxious to see any great increase in production with its proportionate increase in government revenue. It is receiving enough income for a broad goernment-sponsored national expansion and in view of current high prices tends to the concept that a barrel of oil in the ground is worth more in the future than an inflated dollar in the pocket today. For this reason the administration has not granted any new oil exploration concessions recently and probably will not for the next year or two.

Nevertheless, Venezuelan production continues to reach new high marks—hitting an all-time record of 1,197,275 barrels daily the last of July. The companies are currently exploring over 14,000,000 acres of exploration concesseions taken out following the 1943 oil law. In addition the 40,000-barrel Shell refinery on the Paraguana peninsula is almost half finished, and Creole on an adjoining site is in the temporary construction phase of its 60,000-barrel refinery which will be completed by 1949.

In addition to the technical and economic advancement of the Venezuelan oil industry, the companies are equally concerned with a sincere effort to make the "partnership" with the Venezuelan government a complete success. In this respect they are making excellent progress toward creating a permanent and respected place for themselves in the national life.

The companies also are currently profiting from the rise in prices. The producing companies have shown higher profits in spite of increased operating costs and higher taxation. For example, Creole (Standard Oil Co., N. J.), which produces approximately 50 percent of Venezuelan oil, had a net income for 1946 amounting to $83,305,658, or $3.13 per share, as compared to $64,601,781, or $2.43 per share in 1945. That the government is receiving almost exactly the same revenue as the industry's net profit is shown by the fact that in 1945 Creole paid to the government in royalty and all taxes $66,848,678 and in 1946, $80,083,234.

Under the new administration, labor has made substantial gains. In mid-1946 the oil companies signed a collective contract with the petroleum unions for direct and indirect benefits amounting to a 60 percent increase in company labor costs, and the past year has been one of industrial peace. Disputes have been no more than occur anywhere else. As one oil executive phrased it, "Both labor and management have been learning how to live within the framework of a collective contract." The labor policy of the administration has been generally accepted as fair and impartial.

Some rough weather may lie ahead, however. A series of wildcat strikes have been springing up over the country during the past month, although the collective contract does not expire until the end of December this year. These strikes apparently have little to do with a build-up for increased labor demands in the new contract to be negotiated, but instead are allied to the national and international political situation. The majority of the strikes are by Communist unions and seem to be intended to embarrass and cause trouble for the present administration as well as to fit into the planned pattern of current Communist trouble-making throughout Latin America.

The Constitutional Assembly elected early this year has completed the new Venezuelan Constitution, one of the most advanced and liberal in the Western Hemishpere, and is now winding up its labor preparatory to the holding of national

View of storage, temporary office and dock area of the Amuay Bay refinery under construction by Creole.

presidential elections under its terms. The Democratic Action party, which admittedly has the majority of popular support, is nearing the end of a difficult and strenuous two years of government by decree. Communist-inspired labor trouble is calculated to discredit the party prior to the national elections, and the Communists are trying to foment trouble where it could hurt the most—in the vital petroleum industry.

However, the government is standing for no nonsense and is using its full strength to keep the situation under control, even to the point of jailing troublemakers who are patently in violation of the labor laws and the collective contract.

It is a peculiar coincidence that since the arrival of the first Russian ambassador to Venezuela last year, the Venezuelan Communist party has exhibited a remarkable development in technique and organization, and its propaganda is a Moscow carbon copy. Propaganda is even carried to the absurdity of a sound truck blaring through a remote oil camp inciting the workers to strike against "the Truman and Clayton plan."

Neither the Venezuelan government nor the people are communistic, but just as in the United States Communism is a danger and constitutes a fifth column. In case of war Russia undoubtedly would consider the Venezuelan oil fields a major military objective, attack on which could cripple Western Hemisphere oil supply.

Aside from the Communist-inspired labor troubles, bargaining over the new collective contract is not expected to cause industrial strife. Certainly new benefits will be granted, but the government will not advocate the creation of an over-privileged petroleum's workers' class. Government oil policy is distribution of oil benefits to all Venezuelans, and the administration is making every effort to spend its increased oil revenues on projects which will raise the standard and lower the cost of living for the entire nation.

Dr. Perez Alfonzo reports, "In 1946 we acquired through the single industry of oil more than four times the dollars that we had been acquiring in the most prosperous former years. This explains how the budget just presented to the National Constitutional Assembly can reach the unusual amount of Bs1,214,000,000. This sum represents $400,000,000 or around $100 per capita, meaning that we have reached one of the highest levels of expenditure in Latin America, maintaining, notwithstanding, a very limited pressure on the treasury. More than 60 percent of the budget constitutes income which the state receives from its share in petroleum exploitation, in its character as owner of the deposits."

The fact that this budget is four times the average of the budgets from 1938 on and is the highest in Venezuelan history demonstrates that the present administration has not sought "to carry to the just limit participation in petroleum income simply through eagerness to hoard money," he continues.

Venezuela's needs are tremendous. The Minister emphasizes that its four million inhabitants do not produce the necessities for an acceptable standard of living. Its agriculture is insufficient to provide a minimum diet. Illiteracy is 57 percent of those over 15 years old (the administration has been successful in achieving school attendance of half of the 800,000 school-age children, when two years ago only one-third attended). Housing conditions are inadequate, and 60.8 percent live in primitive abodes.

"In compensation," Dr. Perez Alfonzo points out, "nature has given the territory of the Republic great deposits of oil. The proved reserves are very close to eight billion barrels, which represents almost two thousand barrels for each Venezuelan. And the prospects which are already indicated by the exploitation of the cretaceous limes in the Lake Maraicabo zone are truly promising. The new discoveries in the cretaceous can become more important than the reserves already known. Consequently, the Venezuelan people have reasons to feel satisfied, because at least they have the means to overcome their difficulties. Hence, the grave responsibility of those who have in their hands the administration of the public welfare."

Consequently the administration is spending its aboundance of dollars as never before to satisfy the needs of the people, building up new industries, buying essential equipment, merchandise and food. A good part of these dollars is moving back into the United States. In 1938 Venezuela imported $100 million worth of goods; in 1945 despite United States shortages, imports doubled to $200 million, and in 1946 Venezuela imported $315 million. "So far this year we have spent a greater quantity of dollars than those we have been acquiring," Dr. Perez Alfonzo states, "notwithstanding that the increase of petroleum foreign exchange has continued. From the single port of New York in the month of April, fifty-four boats sailed to Venezuela with merchandise valued at $15 million.

"Venezuela has become in this manner one of the principal countries which buys in the United States, where we invest the best part of the profit we take from our petroleum. This, in short, signifies greater sales for United States producers. As much for the farmer who harvests wheat as for the manufacturers of tractors, trucks, electrical apparatus and every kind of implement, the well-being of our country means a guarantee of consumption."

Thus, not only are American oil companies and the Venezuelan government economic partners, but economic partnership and dependence upon each other for mutual well-being extends on an even broader scale to the two nations themselves. It is a tribute to both the Venezuelan government and the American oil companies that the two nations can so develop together.

Temporary residence area at Amuay Bay refinery. This area ultimately will be occupied by permanent refinery office buildings.

MIDDLE EAST OFFERS NO THREAT TO INTERNATIONAL OIL TRADE

EVENTS of the past two years have made the Middle East the center of interest in world oil affairs. Several factors have contributed to this condition. One was the strategic position occupied by this area during the war which inspired the proposal by Washington officials for the construction by the United States of a pipeline from the Persian Gulf to the Mediterranean. The controversy that resulted from this suggestion led to a reappraisal of the reserve position of eastern fields which supported the opinion previously formed by geologists familiar with the region that it held perhaps the greatest deposits of oil existing anywhere in the world.

Keen competition for rights of exploration and exploitation in this great area began long before the vast extent of its petroleum resources was revealed. For nearly half a century the large oil companies serving international markets have been working to establish themselves in this quarter of the world, and many moves on the diplomatic chessboard have been directed to this objective. Latest development, as significant in its way as any that has preceded it, is the decision of a group of American companies, not extensively interested heretofore in operations outside the United States, to enter the field of development abroad with particular attention to the Middle East.

This group of interests, with combined assets of more than a billion dollars, has organized the American-Independent Oil Company with a capitalization of $100 million and has selected as president Ralph K. Davies, whose distinguished service as Deputy Petroleum War Administrator made him an outstanding figure in the oil world and who, for many years preceding, had been an officer of Standard Oil Company of California, being senior vice president at the time of his resignation. Authorized capital stock of the company consists of one million shares of no-par value of which 100,000 are paid in at the rate of $100 per share. Its offices will be in Washington, D. C., and San Francisco, California.

Incorporators of the company are as follows: J. S. Abercrombie, Houston, Texas; Allied Oil Company, Cleveland, Ohio; Ashland Oil & Refining Company, Ashland, Ky.; Ralph K. Davies, San Francisco, Calif.; Globe Oil & Refining Company, Wichita, Kan.; Hancock Oil Company of California, Long Beach, Calif.; Honolulu Oil Corporation, San Francisco, Calif.; Los Nietos Company, Los Angeles, Calif.; Phillips Petroleum Company, Bartlesville, Okla.; Signal Oil & Gas Co., Los Angeles, Calif.; Sunray Oil Corporation, Tulsa, Okla. Directors of the corporation are: K. S. Adams, Vernon Barrett, Jack Blalock, L. A. Cranson, Ralph Davies, Don Emery, Paul Endacott, Russell H. Green, John

The Abqaiq oil field is in a land of drifting sand and rocky plateaus which extends into the vast, empty desert of Saudi Arabia, much of which is unexplored and uninhabited. Photo by Robert Yarnall Richie for Arabian American Oil Co.

W. Hancock, J. Howard Marshall, A. C. Mattei, Sam B. Mosher, I. A. O'Shaughnessy, Frank Phillips, Will J. Reid, W. W. Vandeveer, and C. H. Wright. Vice presidents are K. S. Adams, Sam B. Mosher and J. Howard Marshall.

Explaining the program of the company and the reasons for its organization, Mr. Davies said: "Everyone recognizes that the security and well-being of the United States depend upon ample and continuing supplies of petroleum products. Everyone recognizes, also, that there can be no assurance that all of these necessary supplies can be derived wholly from domestic sources. At this very moment petroleum products are in short supply in the United States and have been for months. For the first time in our history, we have become a net importer of oil.

"Whether this is a temporary situation, which will be overcome when steel and transportation become easier, is something that no one can know. What everyone does know is that demand, both domestically and worldwide, has increased and will continue to increase. It is, therefore, obviously in the national interest that we have access to oil resources beyond our shores, so that we shall be able to supplement our domestic supplies whenever they cannot efficiently meet demands.

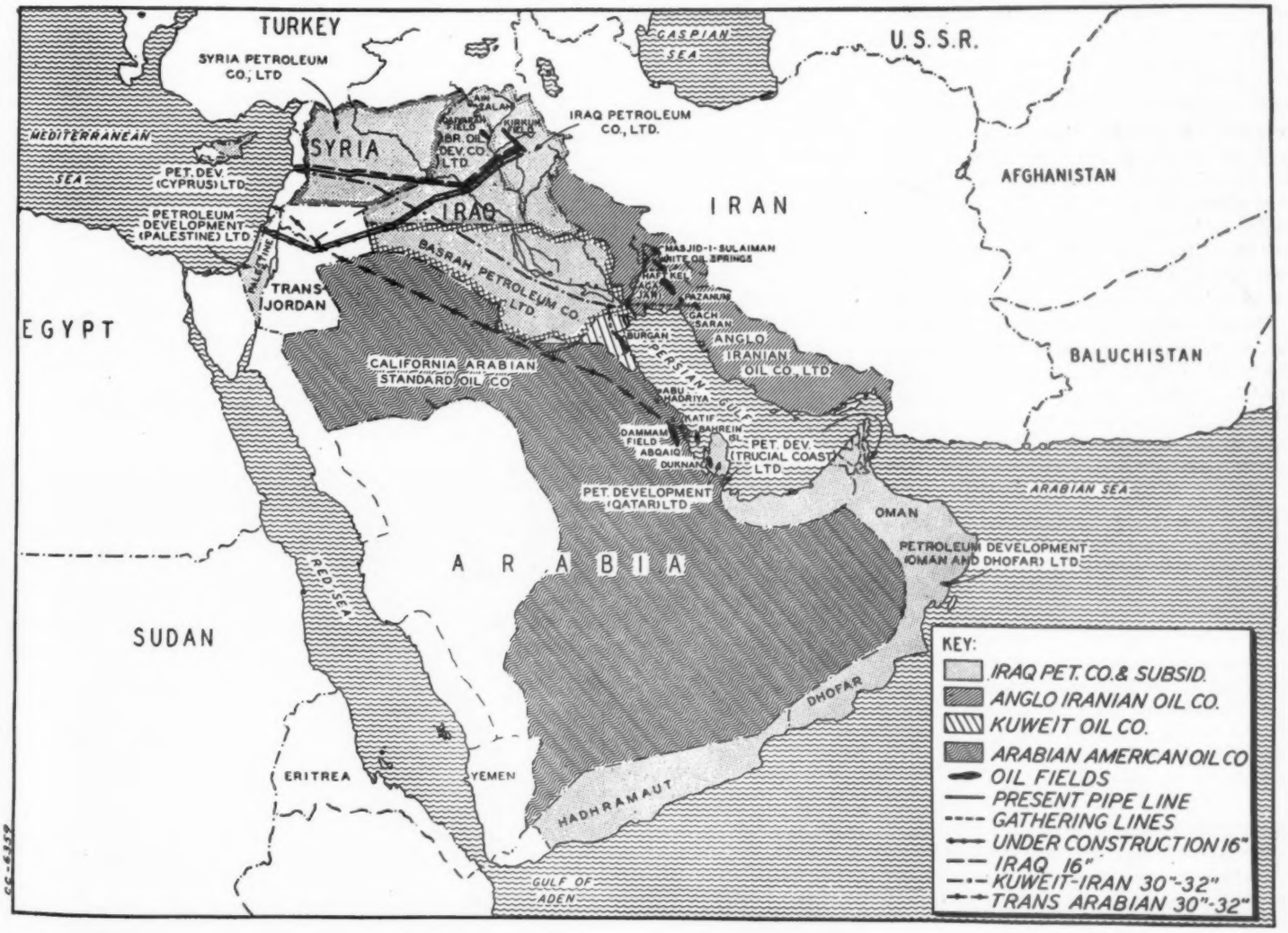
"To this task, the American-Independent Oil Company proposes to devote its efforts. In so doing, it recognizes that the launching of a large-scale, long-term foreign oil program is something of a precedent for independent operators. Heretofore, this field has been developed almost entirely by major oil companies. Foreign ventures by others have been relatively insignificant.

"Nevertheless, we believe that the interest of the American consumer will be best served by the active, substantial and permanent participation of American independent oil operators in the international field. Certainly all will agree that the consumer is in a more favorable position when there is competition by the many, rather than control by the few, however well-intentioned and beneficent.

"We believe that the major concession-holders will, themselves, benefit, particularly from the standpoint of their relationships with the public and the government, by the introduction of wholesale rivalry into areas where control is now concentrated.

"Far more important, of course, than any benefits which may accrue to the petroleum industry are the advantages to the public interest. Before a great many years more oil will probably be produced abroad than in the United States, even if our present high rate of more than 5,000,000 barrels daily should be substantially increased. To deny the benefits of this foreign production to American consumers, to supplement our domestic supply, might subject them to the payment of unduly high prices for products. To deny for-

Map of Middle East showing routes of present and proposed pipelines to the Mediterranean. Courtesy L. F. McCollum, co-ordinator of producing activities, Standard Oil Co. (N. J.) This map was prepared before location of the western terminus of the Trans Arabian pipe line had been settled. Sidon in the Republic of Lebanon now has been announced as the terminus.



eign crude to domestic refineries might force abroad an increasing amount of the refining of foreign crude, and thereby materially lessen our exports.

"The American-Independent Oil Company, therefore, intends to devote its energies to strenghening the American position abroad and to do so in the American tradition of free, competitive enterprise, always mindful that in dealing with an indispensable natural resource, its first duty is to serve the national interest."

While the new company has not announced the acquisition of Mideastern concessions, its declared purpose is to extend its operations to that part of the world, and the existence of large areas considered potentially petroliferous which are not covered by existing agreements apparently makes such expansion feasible. At the same time the direction of American capital and technical skill in increasing measure to the development of resources abroad undoubtedly will be helpful in meeting the unprecedented demand for petroleum products that is developing in all parts of the world.

It is a curious circumstance, considering how recently the Persian Gulf area has come to occupy a place of importance as a petroleum producer, that it was here, in the valleys of the Tigris and Euphrates, that oil was first known and put to use so far as existing records show. Aside from the oft-quoted Biblical references to Noah's employment of pitch to seal the seams of the Ark "without and within" and to the Eternal Fires that burned on the Mesopotamian plain from time immemorial, archeologists have found many tangible evidences of its use by the ancients. Exploration of the ruins of Nineveh, Babylon and other cities of four thousand years ago revealed that an asphaltic preparation was commonly used in the gutters that drained water from the roofs and for various other purposes. Remains have been found of "refineries" dating back to this period in which a crude process of distillation was employed to separate the heavy end-products which were the only ones for which a practical use was known at that time.

With the disappearance of this early civilization, the ruin of its cities and the relapse of its fertile farms into sandy wastes, a curtain descended upon this great area which was not to be lifted for two thousand years. The nomadic tribes that succeeded the former occupants followed an entirely different habit of life. They built no towns, had no use for petroleum products and apparently no knowledge of methods of obtaining them. It was not until the beginning of the present century that interest in the oil potentialities of this great region was aroused.

Pioneer in the opening of the Middle East was William Knox D'Arcy, an Australian, who in 1901 obtained a sweeping concession covering some half million square miles for a period of sixty years, an agreement which was revised in 1933 to reduce the area covered and to extend the life of the concession. Development of the territory by Anglo-Persian (now Anglo-Iranian) Oil Co., Ltd., brought first production in 1907, but Iranian oil did not become a market factor until 1912. Progress was slowed by World War I but proceeded rapidly after its close. Production reached 46 million barrels in 1930, had risen to 78 million in 1939 and under the influence of heavy demand during World War II had mounted to 140 million by 1946. Iran ranks fourth among oil-producing countries of the world, but its yearly output is about the same as that of a single month in the United States.

Even before Iranian oil had demonstrated its importance, a strong international competition had developed for concessionary rights in Mesopotamia, then a neglected province of the Turkish Empire. D'Arcy himself sought a concession in that area which appeared to be on the verge of confirmation when Sultan Abdul Hamid was forced to abdicate by the revolt of the Young Turks in 1908. Another suitor for favors at the hands of the Sultan was Kaiser Wilhelm II of Germany, whose "drive to the East" contemplated an oil concession as well as his projected Berlin to Baghdad railway. Germans actually got to the point of drilling some shallow wells in upper Mesopotamia but were unable to get final confirmation of their application for a concession. Competition between British and German interests was so evenly balanced that neither could win a definite victory, though each group was able to checkmate the other. At length, following the suggestion of Sir Ernest Cassel, the British and German claimants agreed to pool their interests, and the Turkish Petroleum Co., Ltd., was organized with shares held half by Anglo-Persian Oil Co., Ltd., and the other half by the Deutsche Bank and a member of the Royal Dutch Shell group of companies. In the latter part of June, 1914, the Grand Vizier of Turkey, acting for his government, gave to the British and German ambassadors a written promise to authorize exploitation by the Turkish Petroleum Co., Ltd., of the oil resources of two Mesopotamian vilayets lying east of the Tigris River. Five weeks later the start of the war in Europe foreclosed further steps toward implementation of the agreement.

When World War I came to a close, the situation in Asia Minor had undergone a radical change. Turkey had been shorn of a great part of its possessions, and the district covered by the promised grant from the Turkish government became part of the newly-created Kingdom of Iraq, which was placed temporarily under British mandate. It suited the plans of the Allies to regard the promise that had been extended to Turkish Petroleum as still binding. The shares originally issued to the Deutsche Bank had been sequestered by the British during the war, and by agreement between Britain and France these shares were transferred to the latter, a new entrant into Middle East petroleum affairs. By a convention known as the San Remo agreement, the two nations comfortably arranged to share between themselves the development of oil production in the area that had been so long in dispute.

It was at that time that the government of the United States first displayed an interest in Mid-East oil. The Secretary of State vigorously asserted that the San Remo agreement, dealing as it did with mandated territory, was in contravention of the Versailles treaty and a violation of the principle of the open door for which Americans had steadily contended. After many exchanges the American claim was conceded, and the Turkish Petroleum Co., its name changed to the more appropriate one of Iraq Petroleum Co., Ltd., was set up in business with four partners representing British, French, Dutch and Amer-

Political unrest in Palestine which has resulted in destruction of tankage such as that shown in the photograph taken at Haifa has tended to retard final decisions on the location of new facilities on the Mediterranean.

ican interests. Each group held 23¾ percent of the shares, and the remaining five percent was assigned to Participations and Investments, Ltd., a company owned by C. S. Gulbenkian, in consideration of his services in obtaining the original grant. The American interest, originally shared by five oil companies, is now held by two, these being Standard Oil (N. J.) and Socony-Vacuum Oil Co., Inc.

Iraq Petroleum Co. got into active operation in 1927 and brought in its discovery well in that year. Not until 1934, however, when its pipeline to the Mediterranean went into service, did Iraq oil commence to move marketward in volume. This movement was limited to the pipeline's capacity of something over 80,000 barrels daily. By 1939 Iraq's production had reached 30 million barrels and in 1946 it was raised to 35 million. At the present time work is advancing on construction of an additional pipeline which will triple transportation capacity, raising it to between 100 million barrels or more yearly when the line is completed.

In 1930, when the Iraq Petroleum Company was getting under way, Standard Oil Company of California acquired a concession previously held of Gulf Oil Corporation on the Bahrein islands, a small group lying just off the Arabian peninsula in the Persian Gulf. First production was obtained in 1933, and the first cargo of crude was shipped from Bahrein in June, 1934. Production from this field for sometime past has averaged about 25,000 barrels daily.

With definite indications that oil-bearing strata extended along the western side of the Persian Gulf, a spirited competition ensued for concessionary privileges on the Arabian peninsula, the greater part of which had been brought under the authority of Abdul Aziz Ibn Saud, King of the Wahhabi. In 1933 the King signed an agreement giving Standard Oil Company of California full rights to produce, refine and export oil from an area of some 250,000 square miles embracing most of his domain considered likely to be petroliferous. First drilling was done at Dammam near the shore of the Persian Gulf and tapped a prolific field. Later on a field of still greater potentialities was located at Abqaiq, and a single well yielding some 3,500 barrels daily was put down at Qatif. From these fields roundly 250,000 barrels daily is being produced at the present time. Following acquisition by The Texas Company of a half interest in California Standard's eastern holding, the Arabian American Oil Company was organized to conduct operations in Saudi Arabia.

Lying between Iraq and Saudi Arabia near the head of the Persian Gulf is the small Sheikdom of Kuwait, where Anglo-Iranian Oil Co., Ltd., and Gulf Exploration Company are joint owners of a concession granted at the end of 1934. Shipments from Kuwait are about 45,000 barrels daily, but the output of the field is being steadily enlarged.

These are the countries and companies actively engaged at present in oil production in the region commonly referred to as the Middle East. Their output, in thousands of U. S. barrels, is roughly as follows:

Company	Country	Daily Production Barrels
Anglo-Iranian Oil Co., Ltd.	Iran	375,000
Iraq Petroleum Co., Ltd	Iraq	85,000
Arabian-American Oil Co.	Saudi Arabia	250,000
Bahrein Petroleum Co., Ltd.	Bahrein	25,000
Kuwait Oil Co., Ltd.	Kuwait	45,000
Total		780,000

Thus in the thirty-five years since it entered the ranks of the oil producers, the Middle East has advanced to the point where it provides about 10 percent of the world's daily supply. Its output is only about three-quarters of that attained in Venezuela where devolpment began several years later, and it is less than one-sixth that of the United States. In this case, however, the past record is no guide to future performance. Plans adopted by the various companies, some of them already in process of execution, contemplate a very decided increase in activity within the next few years.

Of these projects one of the most important and one on which work is actively in progress is the enlargement of the Iraq Petroleum Company's pipeline to transport more crude from the Kirkuk field. A new 16-inch line is being laid parallel to the 12-inch line which extends from Kirkuk to Haditha where it forks into two branches, one extending to Tripoli in Lebanon and the other to Haifa in Palestine. Completion of this line in 1949 will triple present capacity, raising it to approximately 250 000 barrels daily. Some two dozen additional wells on the Kirkuk structure, the majority of which have been completed, will assure the filling of the line.

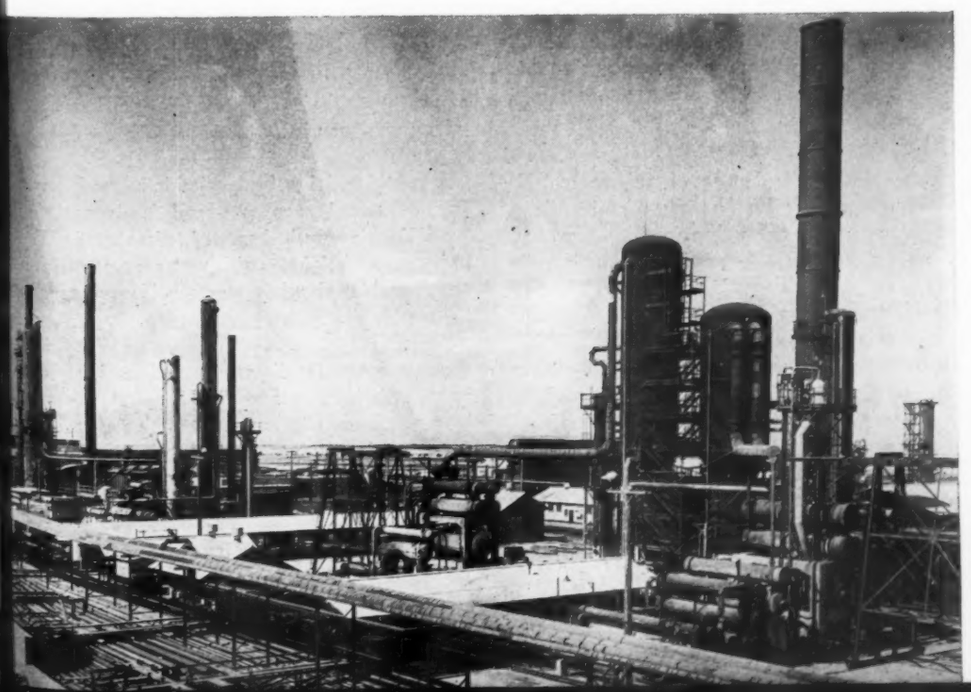
Another addition to Mid-Eastern transportation facilities which has attracted widespread attention is to be provided by the Trans-Arabian Pipe Line Company, a subisdiary of Arabian-American Oil Company, which is to build a line from Abqaiq in Saudi Arabia to Sidon on the Mediterranean. This line, over a thousand miles in length, will consist of pipe of 30-31-inch diameter and will have the greatest capacity of any crude oil line constructed up to this time. Ultimately it is expected to be able to handle 500 000 barrels of crude daily, but its initial load probably will be more like 250,000 barrels. Arabian-American is now engaged in an active drilling campaign to supply oil for this pipeline.

As a result of the agreement arrived at a few months ago for the purchase of crude oil from Anglo-Iranian Oil Company by Standard Oil Co. (N. J.) and Socony-Vacuum Oil Company, a third Persian Gulf-Mediterranean line to be called the Middle East Pipe Line Co., is projected for construction in the near future. One of the reasons given for making this arrangement was the desire to obtain more adequate supplies for Standard-Vacuum Oil Company which conducts its market operations in the Far East and Australasian areas, so it seems probable that first purchases will be routed to that area.

Kuwait oil first became available to the market during the current year. The Kuwait company is jointly owned by Anglo-Iranian and Gulf Exploration, and Gulf's share is now being taken by Shell for use in its eastern sales areas.

Active exploration is being undertaken at a number of points in the Middle East by the group of satellites associated with Iraq Petroleum which hold concessions covering various areas. Two of these companies, Basrah Petroleum and Mosul Petroleum, hold concessions which, between them,

A section of Bahrein Petroleum Company's refinery on Bahrein Island in the Persian Gulf. This plant has a capacity of 115,000 barrels of crude daily and a cracking capacity of 65,000 barrels.



cover all Iraq territory aside from that held by Iraq Petroleum Company itself. Other companies in this group are Syria Petroleum Co., Ltd., and Lebanon Petroleum Co., Ltd., which have concessions in those two countries. Petroleum Development (Qatar) Ltd., Petroleum Development (Oman and Dhofar) Ltd., Petroleum Development (Trucial Coast) Ltd., Petroleum Development (Hadramaut) Ltd., Petroleum Development (Western Arabia) Ltd., Petroleum Development (Transjordan) Ltd., Petroleum Development (Palestine) Ltd., hold concessions in the districts indicated by their names. On Qatar, a peninsula jutting out from the eastern coast of Arabia, a productive well was brought in before the late war, and further drilling since its close indicates the existence of a field of substantial size. Qatar very likely will become a contributor to Middle East production within the next two or three years. Exploratory tests are now being drilled in Syria, in Lebanon and in southern Palestine, and additional drilling is to be done on the holdings of the Basrah and Mosul companies. The results of these tests are still to be determined, and in any event they are not likely to have any substantial effect on world supplies within the next few years.

Production in the Middle East, while of slow growth in the quarter century preceding 1940, was approximately doubled between that year and 1946. Taking into account the activities projected in the way of drilling and pipeline construction in connection with established fields, it is reasonable to expect that it may be doubled again in the next five years. By 1952 the daily outturn may rise to 1,500,000 barrels made up something like this:

Iran	450,000
Iraq	350,000
Saudia Arabia	500,000
Bahrein	25,000
Kuwait	125,000
Qatar	50,000
Total	1,500,000

Of current Mideastern production practically all the oil of Iraq and part of that from Iran goes to the Mediterranean and western Europe. The remainder finds its market east of Suez. When the pipelines now under construction are completed, a similar division will occur. Oil transported by the Iraq and Trans-Arabian pipelines will continue to move westward to the Mediterranean and Western Europe. That which is processed around the Persian Gulf will find its principal market in the East.

It is noteworthy that since the close of the war, demand for petroleum products, despite unfavorable conditions, has risen more rapidly in Europe and the East than it has in the United States or in the Western Hemisphere as a whole. As recovery progresses, this rate of growth will be maintained, if not accelerated. Consequently, if the growth of Middle East production adds 400,000 barrels daily to the supply of the Mediterranean and Western European markets and 350,000 to that off the Far East and Oceania, it will hardly do more than to absorb the growth in demand of those areas.

Along with the rise in production will go an increase in Middle East refining capacity. Throughput of the Consolidated Refineries plant at Haifa, Palestine, is to be doubled to 170,000 barrels daily to handle the large deliveries which the southern fork of the Iraq pipeline will begin making in 1949. Other refineries are to be built, probably one at the Mediterranean terminus of the Trans-Arabian pipeline, possibly another at the western end of the Middle East pipeline when it is laid. Taking into account, however, only the new construction and additions to plants in view for the immediate future, the refining capacity of the area will be somewhere between 850,000 and 1,000,000 barrels daily by 1951.

Fourteen productive fields have been opened thus far in the Middle East. Six of these are in Iran, two in Iraq, one each in Kuwait and Bahrein, three in Saudi Arabia and one in Qatar. Only a small portion of the area has been explored; many more fields undoubtedly will be brought in as time goes on. The section marked by geologists as having structural features favorable to a large oil content is approximately 500 miles in length, extending from the northern part of Iraq and Iran in a south-southeasterly direction along both sides of the Persian Gulf, including the southwestern part of Iran on the east, Kuwait and the eastern part of the Arabian peninsula to the west. This delimitation does not preclude the finding of prolific fields in other locations, but it includes the area within which the drill has uncovered rich deposits in widely separated districts. Production is obtained mostly from limestones and sandstones of the Tertiary and Cretaceous, although in Kuwait the oil is drawn from purely sand formations. In Iraq and Iran layers of heavily saturated limestones varying from 500 to 2,500 feet in thickness have been found. Many salt domes are scattered about the area. The fields in Iran, which have been in production for the greatest length of time, have yielded some 750 million barrels. The famous Haft Kel field in Iran produces over 65 million barrels per year from 24 wells.

Because of the limited extent of exploratory drilling in the Middle East, estimates of its oil reserves can be no more than intelligent guesses. Speaking before a Congressional committee in July last, James Terry Duce, vice president of Arabian American Oil Company, placed the figure of proved and indicated reserves at 30 billion barrels discovered by drilling not more than 175 exploratory wells. Various calculations have been made of total reserves with estimates running up to 150 to 200 billion barrels, but the significance of such figures is their indication that a vast quantity of oil is contained within this group of fields and that they will play a great part in supplying the world's oil requirements for decades, perhaps a century to come.

Because of the size of these fields and the high rate of production of individual wells, apprehension has been expressed by producers in the United States and South America that "cheap" oil from the Middle East might take away the European markets that heretofore have been supplied from this side of the Atlantic, or might even invade the Western Hemisphere in volume sufficient to depress prices and make operations unprofitable. On this subject of the alleged cheapness of Middle East Oil, Mr. Duce gave the Congressional committee his opinions, based on the experience of his company, prefacing them with the comment that a great deal of misinformation about the cost of producing oil abroad had been spread by persons who never had tried to produce it abroad.

"I do not know of a single place in the world," said Mr. Duce, "where, under the same physical conditions, it costs less to drill a well than in the United States. Wells which cost $250,000 to $300,000 in Saudia Arabia could be drilled for half that amount in the United States. It is necessary to use many Americans, and the cost of American labor in Saudi Arabia is double that at home. It costs about $25,000 to build a house for a man and his family on the job. In addition to that, we provide schools, hospitals, medical service, transportation half way around the world, backward and forward, double the vacation allowance in the United States, plus travel time. Single men are provided room and board and married men, living allowances. As to the native labor which has been referred to by some as cheap labor, anybody who has dealt with untrained native people knows that they do not make cheap labor; they are expensive labor. While the wage rates are comparatively low, the amount of labor output is such that on the whole it would pay better to import skilled American labor for everything but the smallest and most simple tasks. We recognize, however, our obligation in operating abroad to employ as much native labor as possible and train it until it can take up a large portion of the work of oil field operation and share as largely in the pay rewards as possible. Trained, the Saudi Arab is an excellent workman.

"In addition, the food, clothing, machinery, equipment and supplies of all kinds used in Saudi Arabia must be imported from abroad. We have to pay freight on this vast amount of material, and much of it moves half-way around the world.

"In addition to the direct costs such as those just mentioned, in a country like Saudi Arabia we have to construct in association with the government, roads, ports, railroads and many other things. As to the payments made to the government itself, royalties in the United States run

from 1/8 to 1/6 of the production. Royalty in the Middle East is not expressed in these terms.

"The royalty on the Arabian American concession is four gold shillings per ton. Under ordinary circumstances with gold at $35 per ounce, a gold sovereign would be worth $8.25. This would mean a royalty on Saudi Arabian oil of approximately 23 cents per barrel. However, gold sovereigns have been sold at a premium in Far Eastern markets, and this has raised some doubt as to the conversion factor. As a result, we cannot tell today what royalty rate we are paying, but 23 cents per barrel paid on the grade of crude we produce is a higher royalty rate than the usual ⅛ paid in the United States at the present time.

"Aside from paying this royalty, we perform, and will in the future perform, numerous services which industry does not perform in the United States. These services include such things as the maintenance of hospitals whose surplus facilities are open to the general public, assistance in the building of sanitary facilities and provision of water supply and electricity without profit.

"If we set down a figure for all these things and made a guess as to what they might total, we come to another factor which is most elusive, and that is the risk in making large investments in foreign lands. I am not speaking here of internal questions inside Saudi Arabia, but rather of the effect of international affairs upon our operations. There are economic risks associated with the actions of governments which may bear seriously upon our operations. For instance, embargoes on products originating in Saudi Arabia, exchange regulations which make it impossible for us to sell in certain markets, quotas, restrictions on the export of supplies, shipping blockades and other obstructions to the free flow of oil caused by local disturbances. I know of no way to guess at the importance of these political and economic factors in any calculation made with reference to cost. Some large factor must be included to take care of these risks and the rate of profit, and the amortization of investment must perforce be made at a greater rate than that used in the United States; otherwise we cannot justify our taking such risks. How much greater these may be I do not know.

"Foreign oil is thus competitive with that from domestic fields only because of the physical conditions surrounding the oil and the fact that most of the concessions are large and we drill on more widely spaced centers that in the United States. For instance, if the East Texas field had been found in Saudi Arabia, we probably would have drilled a fraction of the number of wells actually drilled. It is this ability to operate the foreign fields at technically the most efficient level which makes them competitive and offsets the other disadvantages which are so well recognized by everybody who has operated abroad."

Conditions much the same as those described for Saudi Arabia apply to oil operations in other parts of the Middle East where the companies have to construct roads and towns, schools and recreation centers and provide various kinds of sanitary and social services not required in more fully developed areas. These and other non-operational expenses enter into production costs quite as definitely as the outlay for lifting, processing and transporting oil. Apart from all other considerations, it is to be remembered that the companies most actively engaged in Middle East development have heavy investments in oil in other parts of the world. For purely selfish reasons, if for no other, they would shun the destructive kinds of competition that would depreciate or destroy the value of any of these properties.

It is certain that nothing is further from the minds or intentions of the men responsible for the investment of hundreds of millions of dollars in Middle East oil development than to cause or permit disorganization of international oil markets. This enormous capital investment has been decided upon after a thorough study of the trend in demand for petroleum products in different parts of the world and of the sources of supply best equipped to meet these requirements.

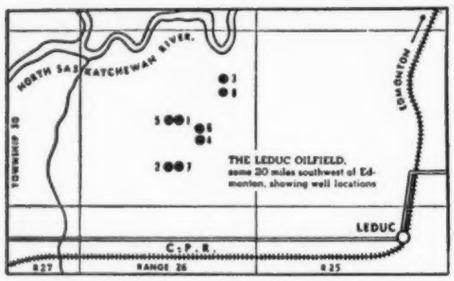
As the result of a careful weighing of all factors, it was concluded that oil fields of the Middle East were in an advantageous position to supply market areas bordering the western Pacific and Indian Ocean areas. By establishing pipeline connections with the eastern Mediterranean, it was felt that this oil could find substantial outlets in the countries bordering the Mediterranean and in western Europe. In the latter area it would come into competition with oil from the Caribbean and might cause its gradual withdrawal, but a weighing of trends in North and South America gave practical assurance that the growth in demand in countries within that area would absorb and in fact require all the oil produced in the Western Hemisphere, even with a large increase in its output. This is the logical course charted for the international oil industry upon the base of past and current statistics. It is true of course that events do not always follow the path laid down for them. It is entirely probable that some quantities of Middle East oil will find their way to countries of North and South America, just as Western Hemisphere oil may continue to go to Europe and the Far East.

Northing appears more certain, however, than that world requirements will readily absorb all the oil that is likely to be produced over the next several decades. And since the fields of the Middle East are being exploited in the scientific, modern manner with full regard to the demands of conservation and avoidance of the wastes that result from overproduction, it appears reasonably certain that this particular area will not become a disturbing factor in the world situation so long as the conditions of management and operation remain as they now are.

Bahrein Petroleum Company has done much to add beauty and comfortable living for its employees in the area in which it operates. Pictured is the company hospital for employees.

LEDUC DISCOVERY ENCOURAGES CANADA

Temporary homes for Imperial employees were set up in an auto park in the town of Leduc.



WHAT may prove to be the most important development of many years in the Canadian oil industry was the bringing in of a discovery well on February 13 last near Leduc in southern Alberta and the demonstration through subsequent drilling that it marked the location of a field of substantial proportions. This discovery takes on added significance because of the conditions that have marked the course of Canadian oil production and because of the hope encouraged by this find that continued exploration may lead to other important petroleum deposits in the prairie provinces.

Drilling to date has proven approximately 5700 acres as being productive. Preliminary estimates place final recoveries at around 10,000 barrels per acre which makes it a 57-million barrel field as it stands today. There is plenty of room for expansion in the 250,000-acre reservation in which the first well was drilled. This year's drilling program calls for 21 wells and Imperial Oil Ltd. now is figuring on spending $50 million in development of the field, installing a pipeline to Edmonton and building a refinery at that point. The company has purchased for $1,000,000 the Canol project refinery at White Horse, Yukon, which was moved from the Texas Gulf Coast during the war to process northern Canadian crude oil for Alaskan military operations. This plant will be dismantled again and moved to Edmonton to process Leduc crude.

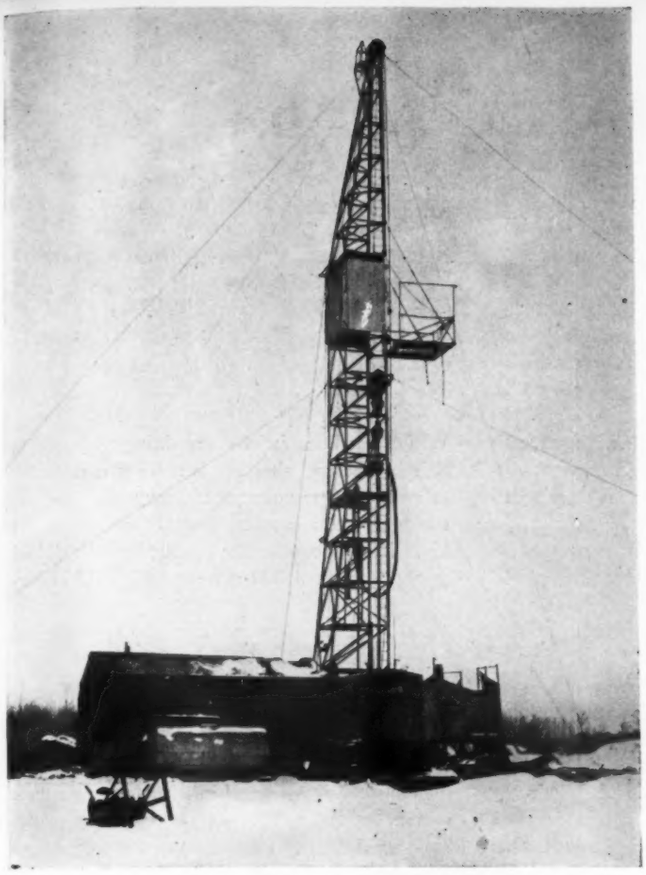
Consumption of oil in Canada is higher, on a per capita basis, than in any other country except the United States and shows the same rapid postwar uptrend that is being displayed by its southern neighbor. Oil has been produced in Canada for a great many years but never in quantity to supply more than a fraction of the country's needs. Its most important field to date is Turner Valley, discovered in 1924 and producing 9,701,719 barrels in its peak year which was 1942. Turner Valley has performed a great national service, particularly in the war years, in supplying the needs of the midwestern provinces, but in spite of continued drilling, its output has been declining for the past several years and has dropped from the nearly 10 million barrels of 1942, when its production was temporarily increased by the sinking of a number of shallow wells under government auspices, to 5,937,362 barrels in 1946.

Total production of crude in Alberta in 1946 was reported as 6,276,645 barrels. As the fuel requirements of the three prairie provinces are in the neighborhood of 15,000,000 barrels annually and steadily increasing, there is obvious need of greatly enlarged production.

Urgent need for oil arising from the war led to an intensification of exploratory activity beginning in 1939. The search extended to many parts of the country from the eastern seaboard to the Pacific. Far in the north the Canol project, backed by the United States Army, led to an extension of the productive area around Norman Wells, but because of its remote location and lack of transportation, it was of little service except to a few scattered industries in that part of the Dominion. In the prairie provinces exploration was stimulated by the declining production of Turner Valley which threatened to leave the refineries of that district with inadequate crude supplies for their operation.

Geophysical crews surveyed large areas of Alberta and Saskatchewan, acting on the opinion expressed by geologists that somewhere in the Devonian limestones deeply underying later deposits, petroleum would be found. The search proved long and tedious, and many dry holes were drilled in its course. A single company, Imperial Oil, Ltd., reports that its expenditures on exploration amounted to $16,500,000 before a measure of success was attained at Leduc. Encouragement to continue the search was provided in 1940 when the Princess well of Standard Oil Company of California produced 35 gravity crude from the Devonian. The Princess-Steveville field was located east of Edmonton, Alberta, while Leduc is situated about 20 miles southwest of that city.

Leduc No. 1, as a wildcat test, was carefully



Leduc No. 2 was drilled with a portable type rig.

Leduc No. 1 was brought in on Feb. 13, 1947.

followed down every foot of the way, frequent cores being examined by geologists on the ground to observe formations. At 5,029 feet saturated cores were recovered from a porous horizon in the Devonian lime and drilling continued to 5,066 feet when casing was set on top of the producing horizon and the well "blew in" on February 13, 1947.

Imperial's second test got disappointing results in its upper porous zone; although oil and gas were present, the formation was much more tightly compacted than in No. 1. Drilling continued until a second porous horizon was encountered from 5,375 to 5,415 feet, with salt water showing at the extreme depth. This gave a very satisfactory exhibition of its potentiality when it came in on May 21.

At No. 3 the stratum which produced in the discovery well was found to be slightly more porous than in No. 2 but less attractive than in No. 1. At 5,176 feet drill stem tests developed a flow of natural gas running to two and a half million cubic feet per day, and from that depth to 5,313 feet porosity was good.

Encouraging showings of oil were met with in the final 16 feet of drilling, and the well was tested at that horizon. After swabbing had removed all but around 2,000 feet of mud from the hole, the well was shut in to build up pressure. At 5:20 on the afternoon of May 21 it showed its first signs of activity and within an hour had cleared itself and was flowing by heads. Thus the company had the unusual experience of bringing in two wildcat tests on the same day.

Well No. 4 was drilled at a point about midway between No. 2 and No. 3. The lower porous zone was encountered at 5,335 feet and penetrated for 17 feet. Porosity here appeared to be greater than at any of the other locations, and the well made an auspicious debut on June 7.

Well No. 5 was brought in on July 21. It closely resembles those previously drilled. Oil was encountered between 5,000 and 5,400 feet and is of 39 to 40 gravity.

All the Leduc wells that have been completed are producing steadily, but their output is being restricted by a 3/16-inch choke to between 175 and 200 barrels daily because the oil has to be transported to refineries by truck in the absence of pipeline connections. Development of the field thus far demonstrates that Leduc is the most important Canadian discovery since Turner Valley. Sites for other wells have been selected and drilling up is scheduled to proceed rapidly.

On the possibility that the seismic anomaly under Leduc may have its counterpart in other areas of hidden Devonian strata, drilling is being undertaken at Looma, roughly 20 miles east from the Leduc producers. A location has been selected near Morinville, 18 miles north of Edmonton. Southwest of Leduc, in the Pigeon Lake area, Imperial-Battle Lake No. 1 is preparing for a deep test. Sixty-five miles northwest of Edmonton, Paddle River No. 1 is being put down.

With the initial success that has attended drilling operations at Leduc, a great amount of interest has been aroused in surrounding areas. A number of Canadian and several United States companies have made leases covering millions of acres in Albert and Saskatchewan, and intensive surveys and tests of this whole region undoubtedly will take place during the next year or two.

Aerial view of the prairie country near Leduc with well No. 5 in the foreground. National Film Board photo. Other photographs with this article are by Corsini for Standard Oil Co. (N. J.)

OIL CONSUMPTION RISES SHARPLY IN ALL PARTS OF THE WORLD

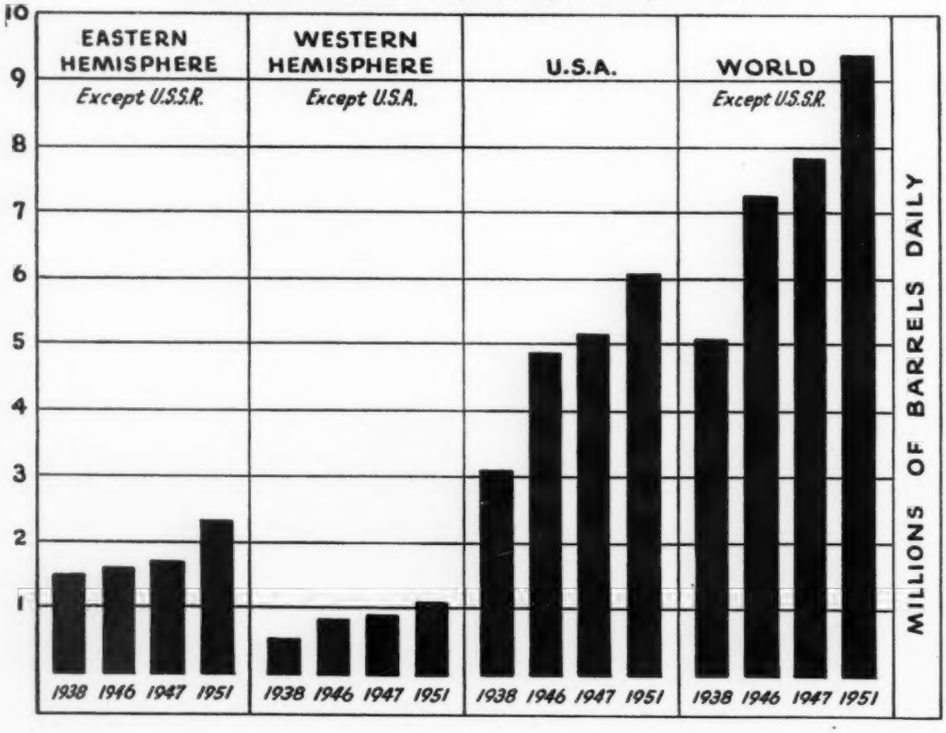
THE oil industry in the United States has begun to breathe a little easier. The summer motoring season has passed its high point, and there has been no gasoline shortage of real consequence. Informal rationing by suppliers has tended to preserve equities, and isolated run-outs have been cured in a matter of hours by emergency action.

The next immediate problem is how to get through the winter without permitting home owners to suffer from the cold. This may be an even tougher assignment than meeting the summer tourists' needs. The increase in motor fuel consumption has been on the order of six percent, whereas distillate fuel demand was up 24 percent in the first five months of the year. As a matter of fact the winter months now are the peak consuming season in the United States. Fourth quarter domestic demand this year is expected to be nine percent higher than the third quarter and first quarter next year, 12 percent higher than the third quarter of 1947.

Elsewhere in most parts of the world, the current increase in oil consumption is even greater than in the United States, and sales could be increased substantially in many areas if supplies were freely available. European consumption outside of Russia and satellite nations is running 15 percent above last year. Consumption in the eastern hemisphere is up 26-27 percent over 1946. Western hemisphere consumption in 1947 outside of the United States will be about 8.5 percent above 1946.

In the United Kingdom imports of petroleum and products were 23.3 percent lower in the first half of this year than in the corresponding months of 1946 and 7.3 percent below the first half of 1938. There may have been a substantial change in stocks, however, so it should not be assumed that consumption decreased by that amount. Due to the necessity for currency conservation, the British are continuing wartime rationing of petroleum. The rationing even extends to such products as kerosene. Recently the government decided to reduce consumption of motor fuel by a third. This will cut imports by about 3,500,000 barrels yearly. Currently there is some discussion as to whether gasoline should not be made freely available to tourists on the theory that their their expenditures of dollars would aid the British economy.

Estimated oil demand in 1951 compared with present and prewar demand.



While gasoline rations are being reduced in Britain, the coal shortage is making it necessary to import larger volumes of heavy oils. During the war years consumption of gas oil in the United Kingdom for the production of artificial gas has increased 300 percent to 3,500,000 barrels per year. British railroads are converting 1,200 steam locomotives from coal to oil and will burn about 5,000,000 barrels of fuel yearly. Diesel electric locomotives are finding a little wider use on British railroads but not to the same extent as in America. The British steel industry also is converting from coal to oil. By the end of this year steel mill consumption there will be up to nearly 7,000,000 barrels yearly. Steam and electric plants also are turning to oil.

The British conversion drive was begun in the spring of 1946 and by March of this year had added 7,000,000 barrels to fuel oil demand. An added 5,000,000 barrels of oil will be needed this year, and by the middle of 1948 conversions already approved will increase United Kingdom fuel oil consumption some 35,000,000 barrels. These figures assume that steel will be available for fuel oil tankage and for conversion burners and piping. Actually the steel shortage may delay conversions.

Contrasting with the United Kingdom oil imports into Eire increased 29 percent in the first two months of this year over the same period in 1946. On the continent of Europe increases in imports and consumption are running from 20 to 100 percent over last year. There, as well as in Britain, conversion to heavy fuel oil is being undertaken by industry where there is a possibility of obtaining a supply. Coal is short everywhere on the continent.

Norway is an interesting example of a European country which was virtually shut off from oil imports during the war and which now is showing a resurgent demand for petroleum products. In 1946 Norway imported 4.7 million barrels of oil compared with 1.4 million barrels in 1945, an increase of 250 percent. Imports thus far this year are running 31 percent higher than in 1946 and are expected to top 6.2 million barrels. This will be an increase of about 15 percent over the last prewar year when imports totaled 5.4 million barrels.

Other Scandinavian countries are consuming largely increased quantities of oil. Swedish im-

Oil is moving again on Europe's inland waterways. Belgium, for example, has repaired 1,000 miles of canals and barge tonnage is up to 90 percent of prewar. Photo by Paula Foa from British Combine shows oil shipments in Amsterdam.

ports also will be up more than 30 percent this year to around 19 million barrels. Imports into Denmark are running twice as large as last year. Finland is the only nation in the Scandinavian group which is not showing very large imports.

Western European nations outside the Russian sphere of influence are hundry for oil. Holland is importing 20 percent more oil than last year, France about 40 percent, and Belgium nearly twice as much as in the same period in 1946.

In the eastern hemisphere "East of Suez" consumption of petroleum products has been running 26 to 27 percent above 1946. In some areas the increases could have been much greater if supplies had been available, or if currency problems had not been acute. Marketing in some countries, of course, is just beginning to open up after wartime stagnation, and percentage figures carry little meaning for that reason. In India there has been an actual decrease in deliveries of petroleum products for consumption because of the decline in military activities. The 26-27 percent increase suggested is a general figure for the entire eastern area.

As between products the largest increases have been in demand for diesel oil, fuel oil and motor gasoline. Kerosene consumption is generally steady in the Orient, varying only a few percent. Aviation gasoline consumption has, of course, declined substantially because of the decrease in military usage.

In Latin America as a whole an increase of at least six percent in demand for petroleum and its products is anticipated this year. Consumption in Argentina is running 13 percent over last year. In Brazil the increase is about 16.5 percent while in Cuba it is estimated that this year's demand will be only about two percent higher than 1946. The six percent overall increase in Latin American oil demand this year may be somewhat misleading when compared with Europe and the Orient. European demand in 1946 was less than prewar. Russian oil use was down, and the eastern hemisphere outside Russia was only slightly greater than prewar. Latin American oil consumption, on the other hand, continued to increase year by year during the war. Mexican consumption in 1946 was 51 percent greater than in 1941, and the remainder of Latin America consumed 32 percent more oil than in 1941. These increases compare with 20.5 percent in the United States in the same period. Per capita oil consumption in Latin America now averages 1.7 barrels per year, a greater volume than is used in Europe.

In the United States stocks of motor fuel on May 1 stood at 102 million barrels. Before the war such a stock level would have frightened refiners and created a soft market. But with domestic demand for this product averaging two million barrels daily in the first five months, the only apprehension was whether summer requirements could be met.

By August 1 motor fuel stocks had been cut 16 million barrels, and consumption was up to 2.4 million barrels daily. Total stocks of gasoline thus represented only 34 days supply on August 1 compared with 50 days on May 1. Actually most of this gasoline was working stock and not a real reserve which could be drawn on to supply vacationers.

The oil refining industry did a magnificent job in getting through the summer as well as it did. Early in August U. S. refineries were operating at 93 percent of capacity. East Coast and Louisiana Coast refineries were being operated well in excess of rated capacity. Added throughput was obtained at many plants by speeding normal overhaul jobs. Standard of New Jersey, for example, reduced turn-around time a third on one of its big catalytic crackers at Linden, New Jersey. By putting 360 men on the job, the 20,000-barrel unit was overhauled and put back on stream in 14 days instead of the normal 21. This added

140,000 barrels of needed products to the nation's supply. Standard of Indiana reported that crude runs to its 12 refineries during July averaged 41,000 barrels daily higher than in the same month of 1944, an increase of more than 1,250,000 barrels for the month. These are not isolated examples. Similar records have been made by refiners throughout the country.

Where pipelines were inadequate to bring in enough oil to keep stills operating at capacity, refiners have resorted to tank cars. This has increased costs substantially, but refiners have been willing to shoulder the burden to keep customers supplied.

As mentioned previously the oil industry is breathing a little easier then earlier in the year. At the end of the first quarter domestic demand for petroleum and products was 13 percent above 1946. Projected through the year, this suggested a daily average domestic requirement of 5,500,000 barrels daily. Fortunately the 13 percent increase rate has not been maintained. It now stands at about 8.5 percent and is expected to end the year at 9.5 percent, requiring an average of 5,365,000 barrels of oil daily through the year.

The major unknown at this moment is what the weather man will provide in the way of cold during the coming winter. Degree days will tell the story, and there is nothing much that can be done about it except to run as much crude as possible and hope for the best.

The wartime shortage of domestic oil burners now seems definitely on the mend. Fractional horsepower motors are in better supply, and burner manufacturers seem to be getting enough steel to compile imposing production records. Home owners seem to have both the necessary cash and the desire to buy all the burners that come off the assembly lines. In the first half of 1947 distillate-burning, central-heating plant installations totaled 271,000. Total in place on June 30 was 3,100,000. The increase of ten percent in the six-month period is an astonishing figure and a bit disconcerting too, when it is remembered that the increase was made in a period when steel and fractional horsepower motors were scarce. Current estimates are that installations will total 3,320,000 by Dec. 31, 1947, and that fuel demand will increase another 12 percent in the 1947-48 heating season.

Diesel engines which compete with oil burners for fuel are contributing to the fuel shortage. Consumption of diesel fuel this year is estimated at 62 million barrels, an increase of 150 percent over prewar. Railroads and trucks are heavy contributors to this increase. Although two gas turbine locomotives designed to burn pulverized coal are being built, the momentum already achieved in railroad dieselization is such that, even if this type of locomotive is successful, it is clear that diesel fuel demand from the railroads will rise for a good many years to come.

In normal times it is possible to vary yields of principal oil products appreciably. Distillate fuel production can be augmented at the expense of gasoline and vice versa. This does not seem feasible now, however, when demand for all products is crowding supply. Also, at top capacity, refineries are not as flexible as at part capacity. Thus far in 1947, distillate yields at United States refineries have averaged about 16.4 percent of crude, about the same as last year.

There is, of course, nowhere nearly enough residual fuel to meet the requirements of industrial consumers who would like to convert from coal to oil and avert the fear of John L. Lewis. The residual fuel situation also is made more acute by the military demand. War stocks have been used up, and the military is asking for 38,000 barrels daily of gasoline for planes and 100,000 barrels daily of heavy fuel.

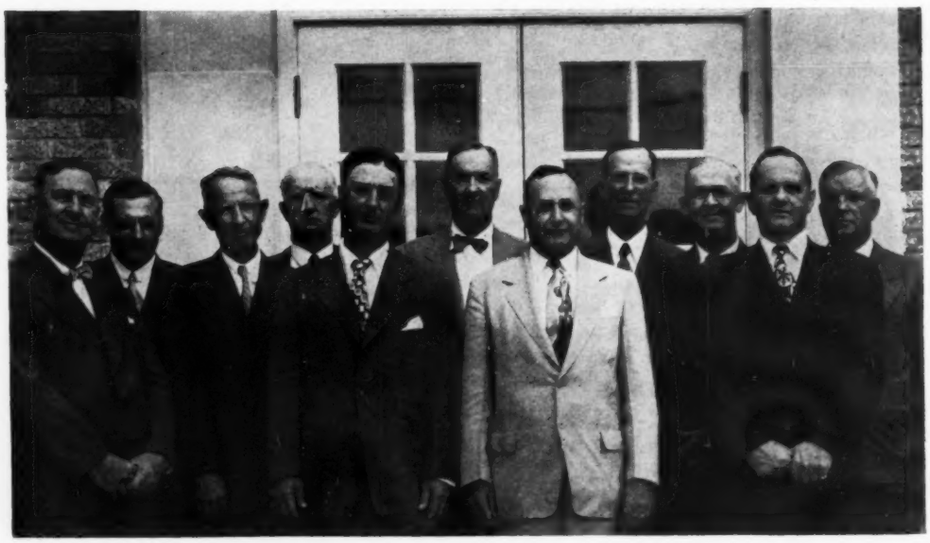
On the long pull as well as during the coming winter, the industry, both in the United States and elsewhere throughout the world, recognizes that it must work diligently to keep ahead of demand. Forecasts of world demand made by oil economists do not indicate that there can be any relaxation of exploration, drilling or refining activity for a number of years. Especially must the industry enlarge its transportation facilities, pipelines, tanker fleets and tank cars.

TABLE I

World Supply & Demand (Excluding Russia) [1]
1946-1951

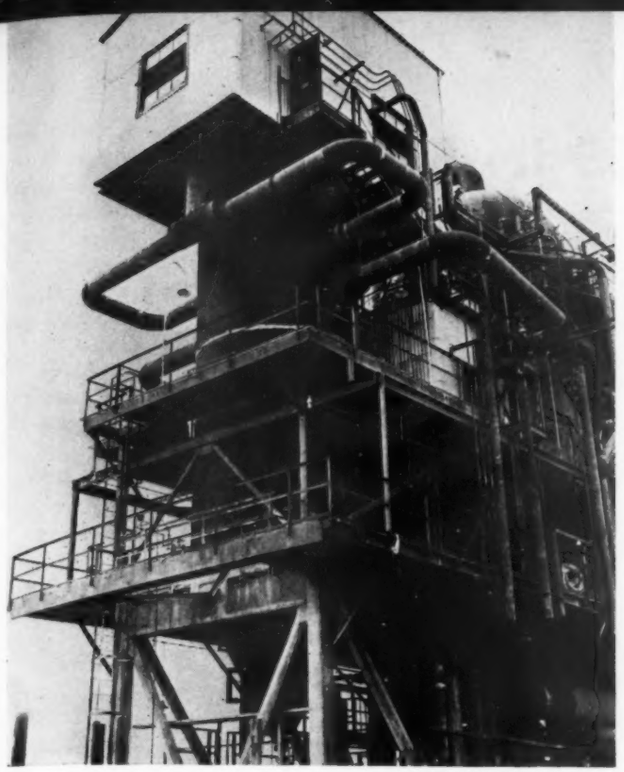
	Barrels Daily				
Demand	**1946**	**1947**	**% Increase Over 1946**	**1951**	**% Increase Over 1946**
U. S. A.	4,907,000	5,199,000	6.0	6,025,000	22.8
Western Hemisphere (ex U. S. A.)	820,000	888,000	8.3	1,080,000	31.7
Eastern Hemisphere (ex Russia)	1,527,000	1,721,000	12.7	2,288,000	49.8
Total	7,254,000	7,808,000	7.6	9,393,000	29.5
Stock Increase (U. S. A.)	119,000	39,000		—	
Stock Increase (Foreign)	58,000	—		11,000	
Shipments to Russia	48,000	48,000		25,000	
Total	7,479,000	7,895,000	5.6	9,429,000	26.1
Supply					
U. S. A. Production (Crude & Natural etc.)	5,070,000	5,254,000	3.6	5,576,000	10.0
Western Hemisphere (ex U. S. A.)[1]	1,455,000	1,565,000	8.3	1,896,000	31.2
Eastern Hemisphere (ex Russia)[2]	964,000	1,076,000	11.6	1,957,000	103.0
Total	7,479,000	7,895,000	5.6	9,429,000	26.1

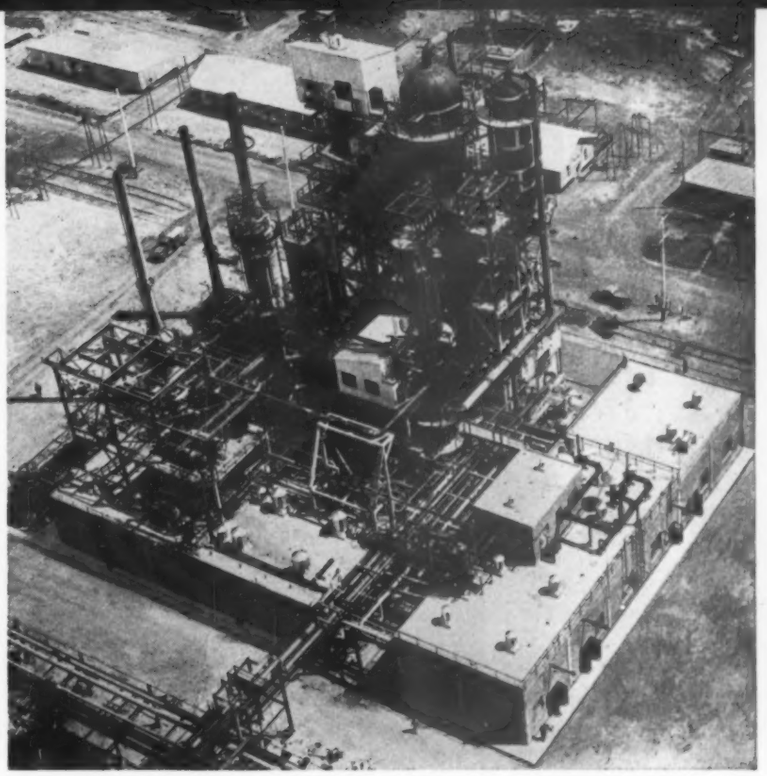
[1] Estimates prepared by H. W. Page, coordination and economics department Standard, Oil Co. (N. J.) for presentation before Independent Petroleum Association of America.
[2] In addition, U. S. exports to Russia are 8,000 B/D in 1946 and 1947.



Wyatt Directors Meet in Houston

Officers and directors of the Wlatt Metal & Boiler Works who attended the regular quarterly meeting of the board of directors recently held in Houston. Following the meeting directors inspected Wyatt's Houston plant and office facilities which have been modernized and greatly expanded during the past several months. It was the first board meeting in the history of the company to be held in Houston. All previous meetings have been held at the Dallas offices. Officers and directors shown in the photograph are from left to right: H. P. Willard, director, Dallas; Frank E. Austin, Jr., director, Dallas; J. Warren Jones, director, Dallas; W. H. Dwyer, Sr., director, Dallas; Walter B. Van Wart, executive vice president, Houston; Henry R. Davis, vice president, Dallas; Raleigh Hortenstine, president, Dallas; C. R. Moore, vice president, Dallas; Guy Gambrell, secretary and treasurer, Houston; George E. Gude, Jr., vice president and manager of sales, Houston; and Ralph W. Malone, assistant secretary and treasurer, Dallas.





New type cylindrical Cottrell precipitator saves a third in first cost and operates better at higher pressures. At right is aerial view of the new unit.

SMALL FLUID CAT CRACKER ON STREAM IN WYOMING

FIRST small Kellogg fluid catalytic cracking unit built since the war recently went on stream at the Casper, Wyoming, refinery of The Texas Co. The unit was designed to charge 4,000 barrels daily of gas oil, roughly the gas oil production from 10,000 barrels of Cody crude processed at this point. The M. W. Kellogg Co. also is building or revamping a number of other units at this refinery, including catalytic polymerization, naphtha reforming and pressure coking facilities.

A new "balanced pressure" design is embodied in the small cat unit. As a result, reactor and regenerator are supported at the same levels; an overall reduction in height has been effected; and standpipe heights have been reduced. The reduced standpipe heights in turn enable a lower pressure drop to be maintained across the slide valves and so eliminate much of the erosion formerly found in these critical catalyst controlling mechanisms. Piping, too, has been simplified with short direct runs to all major vessels and with only one expansion joint in the whole unit.

Plan of the compact 134 x 190-foot plot brings the reactor, regenerator and precipitator into line in a main structure at the extremity of the battery limits. At the opposite face of the oblong a second row of vessels brings the fractionator and gas recovery equipment into line. Three stills employed in the unit also are in line. This oblong arrangement, open on all four sides with all big vessels on the outside, enabled each vessel to be lifted into position as soon as it arrived on the job site without interfering with other erection proceeding simultaneously. The installation of piping, structural steel and internal auxiliary vessels was not delayed by this outside arrangement of the big vessels, nor did each large vessel in position interfere with the installation of its neighbor. In a period when some items are delayed due to manufacturing difficulties and steel shortages, this paid off in reduced construction time.

An interesting feature of the unit is a new cylindrical Cottrell percipitator designed to operate at a much higher pressure than any previous electrical precipitator. It replaces the former box type and saves one-third of the investment cost of former designs through greater ease of fabrication on a leak-free basis and through reduction of reinforcing.

The substation on top of the precipitator contains transformer and rectifier equipment to convert plant 400 volt AC current to 50,000 volt DC current, which potential is applied across the precipitator to recover fine catalyst particles in the waste flue gas.

Consolidation of the fractionator into a trifunctional vessel with a rectifying section, desuperheater and slurry settler all included in one tower has also reduced initial costs and improved the safety of the unit by eliminating danger of flash.

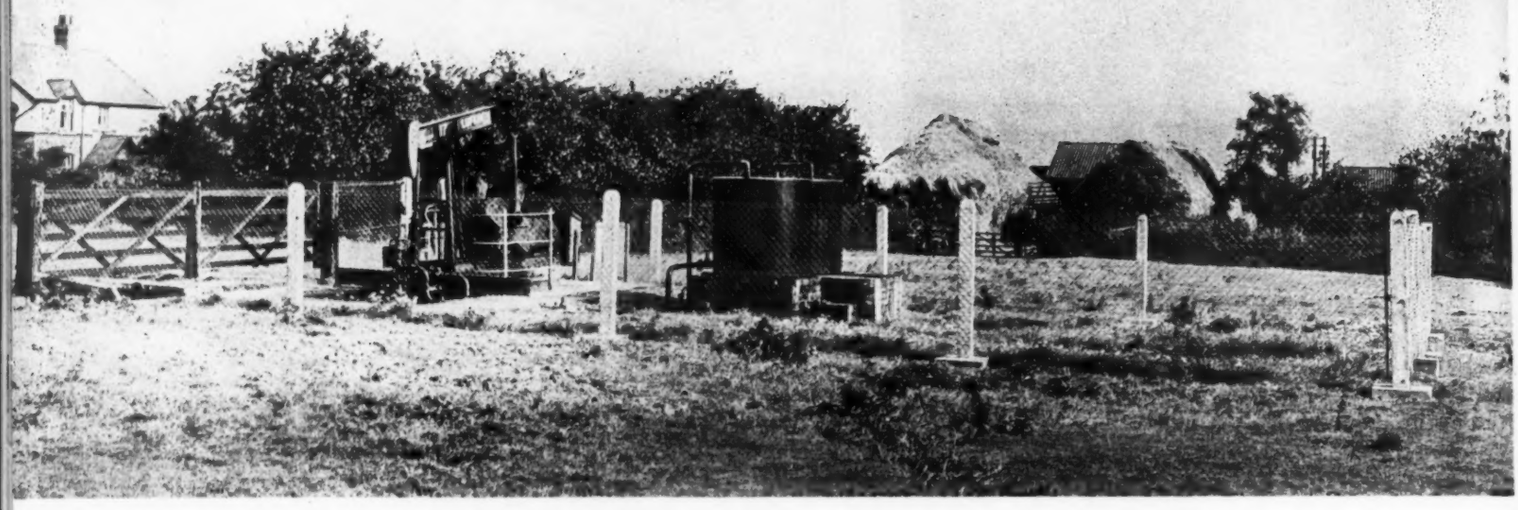
An outside stripper, separate from the reactor, more efficiently disengages oil from catalyst and returns the oil vapors to the top of the reactor. Preventing oil from entering the regenerator with the spent catalyst reduces the size of the regenerator and the air-blowing equipment required.

All pumps, compressors and blowers employed on the unit are steam driven. A majority of the steam required is provided by recovery of heat from flue gases and from the hot slurry circulated to de-superheat the reactor vapor.

Due to the high sulfur content of the gas oil to be processed at this plant, the engineers made generous use of alloy steels. All major vessels except the regenerator were shop fabricated.

With the addition of this new unit, The Texas Co. now has more than 100,000 barrels of catalytic cracking capacity at its many refineries in various sections of the United States.

OIL SEARCH CONTINUES IN BRITAIN



By E. Lawson Lomax

BRITAIN'S search for oil may be said to have had its start in 1918, although records show that indications of petroleum date back as far as 1637. The first Lord Cowdray, who had been responsible for developments in Mexico at the beginning of the century, took the lead in that effort and was ably assisted by Lord Cadman (at that time Dr. Cadman) and Sir Boverton Redwood. The net result of this early investigation was the small production obtained from the Hardstoft well which was brought in in May, 1919, with a production of about six barrels per day. Other wells drilled at that time were all dry except for minor showings of oil and gas.

This Hardstoft well, although showing the presence of oil in the country, was far from a commercial proposition; further exploitation was difficult in view of the number of British landowners who, having sub-surface rights, thought only in terms of their small acreages and it was not until the passing of the Petroleum (Production) Act in 1934, when the sub-surface rights were transferred to the state, that entry to the land for the purpose of exploration and exploitation was facilitated. Lord Cadman was a driving force behind the government in the passing of this act.

Shortly after the passage of the act, the following companies took out licenses for various areas: D'Arcy Exploration (Anglo-Iranian Oil Co.), Anglo-American, Gulf Exploration (G. B.) and Steel Bros. & Co. None of these companies except D'Arcy Exploration met with any success, and all except this company have by now surrendered their licenses.

D'Arcy Exploration Co., however, is taking up further licenses, the latest one noted in the London Gazette for June being for five square miles in the County of Nottingham. The first boring under the act was commenced by the staff of the Anglo-Iranian Oil Co. in January, 1936, at Portsdown in Hampshire.

The accompanying map shows the oil prospects in the country, which are spread over separate and unrelated geological provinces. The exploration programs of geological prospecting, geophysical (gravity, magnetic and seismic) testing and test drilling were designed to cover each separate province as thoroughly as possible.

The early drilling in the South of England was not successful, while a test well at Cousland near Dalkeith, Scotland, and one at Aislaby in Eskdale, Yorkshire, gave only shows of gas, and it was not until the middle of 1939 that oil in commercial quantities was struck.

The first strike was a small producer from a shallow well at Formby, Lancashire, but this was followed soon after by the finding of commercial production at Eakring in Nottinghamshire. This well was brought in on June 19, 1939, at a depth of 1912 feet with an initial production of 87 barrels per day.

The outbreak of war in September of that year developed a new situation, and in view of the possibilities of further commercial production, it was decided to concentrate activities here and reduce or cease activities in other projects scattered about the country. In this area four domes were located—at Eakring, Duke's Wood, Kelham and Caunton—and active drilling was carried out in each area.

Each oilfield consists of a simple dome, containing separate oilsands which are sometimes lenticular. The Rough Rock, a hard standstone varying from 50-100 feet in thickness, is the main producing horizon in the Eakring field, which is about two miles long by half a mile wide. Four separate oil sands yield production in the center of this field, while in the smaller Kelham and Caunton fields, only two sands are present. These are also thinner, being only about 30 feet thick and separated by some 70 feet of shale. Each sand has its own particular type of crude oil and edge water. The oil horizons lie mainly in the Millstone Grit series of the Upper Carboniferous, but

they extend into the basal part of the lower coal measures. The sandstones vary considerably, both in porosity and permeability, the former ranging from 0-20 and the latter from 2-1000 millidarcies. The oil column is small, being of the order of 250 feet at Eakring and only 50 feet at Caunton.

The spacing is one well to two and a half acres on the Eakring field, and one well to three acres of the Kelham and Caunton fields, these spacings being considered satisfactory for the reservoir characteristics. Initial well productions varied from seven barrels per day to as high as 375 barrels per day. When, however, the infilling drilling program had been nearly completed, it was found that the later wells drilled yielded approximately the average production to which the majority of wells had declined at that time. The gas-oil ratios are small, varying between 10 and 20 volumes of gas to one of oil.

The original reservoir pressure in the Eakring field was approximately 990 pounds per square inch at datum level of 1700 feet below mean sea level, the highest recorded closed-in pressure being 300 pounds per square inch. All wells yielded a small flow, the highest flowing production recorded in an initial production test being 100 barrels per day. The original saturation pressure of the gas in the crude oil was 390 pounds per square inch.

The reservoir pressure in the Rough Rock has fallen since production started to 350 pounds per square inch, whereas the pressure in the Chatsworth Grit has fallen only to 700 pounds per square inch. Prior to production, the reservoir pressure at Kelham was 1220 pounds at a datum level of 2000 feet below sea level. The original pressure of gas in this field is, however, extremely low, being only 90 pounds per square inch. Reservoir pressures in the Middle Grit have declined as a result of production to 700 pounds per square inch and in the Upper Grit to 250 pounds at a datum level of 2000 feet.

There is a considerable difference in the rock temperatures of these fields, the temperature at Eakring being much higher than at Kelham Hills, which the following table shows:

Depth below mean sea level, feet	Eakring	Duke's Wood	Kelham Hills
500	61°F	60°F	57°F
1000	75°F	70°F	63°F
1500	95°F	85°F	72°F
2000	118°F	103°F	83°F

The formations drilled through in the producing fields are as follows:

Trias

Keuper: Marls and sandsones, 200-500 feet thick
Bunter: Water-bearing sandstones, about 500 feet thick

Permian

Shales and Marls: 200 feet thick
Limestone: 150 feet thick

Carboniferous

Coal Measures: Coal-bearing series, 700-800 feet thick, the higher beds of the coal measures having been removed by erosion, with coal seams a few inches to six feet in thickness, and then irregular oilsands in the basal part.

Millstone Grit Series: 200-750 feet thick; sandstones and grits with shale bands and fireclays, the main oil horizon being the Rough Rock, 50-100 feet thick, the topmost sandstone of the series.

D'Arcy Exploration Co., Ltd., leases where exploration is continuing in the United Kingdom.

Rockbits were necessary throughout the drilling and this gave rise under war conditions to the problems of supply, an average life for a bit being about 100 feet when using a viscous, chemically treated mud made of dry ground coal measure shale, to which was added a bentonic material available in the country. By alteration of the circulating fluid, the footage drilled per bit was increased, as much as 800 feet having been attained with one rockbit. In addition, the installation of a bit service for reconditioning the bits increased this life by an average of about 70 percent.

The footage drilled to the end of 1946 was as follows:

Deep boreholes (a) Test	217,062 ft.
(b) Production	564,184 ft.
Smaller boreholes for geological information	51,472 ft.
Total footage drilled	832,718 ft.

The outbreak of war shortly after the drilling in of the first well at Eakring gave a great im-

petus to the commercial production and at the same time brought its own particular problems. The heavy rigs and drilling outfits originally purchased for the exploration program, which envisaged drilling to depths of 8,000 feet, were not very suitable in many ways for rapid exploitation of a field where production was obtained at relatively shallow depths of 2000-2500 feet. Heavy derricks, 136 feet and 94 feet high, and drilling machines of various makes were in use which necessitated a large amount of clearing and road-making.

The shortage of manpower and road-making equipment, together with the restrictions on steel so urgently required for munitions and shipbuilding, was the problem, while in addition shipping space not being readily available for the transport of American equipment, such as tools and drill pipe, was another problem of considerable dimensions which, however, was finally overcome.

For road-making the assistance for a short time of the Canadian Road Construction Engineers was obtained, and they with their trained men and mechanical equipment were able to construct some of the roads. Progressive improvements in drilling technique and plant were made with the object of conserving materials and achieving faster drilling speeds. Concrete foundations and sub-structures were replaced as far as possible by recoverable timber mats. The drilling rigs were converted to electrical power, and power lines, water lines and mud lines were run to each forward location. The water lines served as oil lines when the wells were completed and production obtained. These improvements reduced the completion time of a well to about three weeks in 1942, but the moving and re-erection still took two weeks, making a total of five weeks, which was, however, an improvement against the total of nine weeks required in 1940.

Owing to the urgent need of maximum oil production in Britain, permission was granted by the Petroleum Division in 1942 for equipment and manpower to be imported from America. Complete drilling teams were imported, who, with their superintendents, did a splendid job of work during their 12 months' stay in the country.

Unitized drilling rigs with jack-knife portable derricks designed to give maximum mobility and to drill to 5,000 feet with four and a half-inch drill pipe were obtained. The deepest well so far drilled was carried out with this type of outfit, with the exception that it was incorporated with a 136-foot derrick instead of the 87-foot mast; a depth of 7,476 feet was reached, and then the well as abandoned without mechanical failure after coring in old rocks.

In a sequence of ten production wells drilled averaging 2000 feet and all completed as producers, the drilling times averaged 62 hours of drilling for an 8⅝-inch hole, that is, an average of 31.9 feet per hour. The time required to change bits at 2000 feet and resume drilling was approximately 50 minutes, and the average time required to lay down 4½-inch drill pipe, run and cement 8⅝-inch coring was 7¾ hours. The average time required on these ten wells to drill-in and complete with lines, tubings and rods was 28 hours. The total time, including a 48-hour shutdown for cementing was seven days. These times were attained in spite of black-out regulations and delays owing to air-raid warnings, when in the early days drilling was suspended.

In the Formby field the small production is obtained from very shallow wells, that is, averaging about 100 feet deep. The oil is struck in the upper beds of the Keuper Waterstones, the whole area being overlaid by peat deposits. In all, 45 wells have been drilled, and the limits of this oil pool have been determined both laterally and vertically.

The highest production from the field was in 1940, when from 11 wells an average daily production of six tons was obtained. During 1941 and 1942 production declined, the oil-water ratio decreased, and a number of wells were abandoned, having gone entirely to water. In 1943 and 1944 the decline appeared to have been arrested, and an average daily production of two and a half tons from nine wells became steady.

The total production from Eakring and Formby areas up to the end of 1946 was as follows:

1939	3,145 tons
1940	16,689 "
1941	29,992 "
1942	81,298 "
1943	112,760 "
1944	94,570 "
1945	71,542 "
1946	55,387 "
	465,383 tons

It is thus seen that there was a rapid expansion during the early war years, followed by a decline to about half the peak production by the end of 1946. Apropos of this the chairman's remarks to the shareholders of the Anglo-Iranian Oil Co. on July 17, 1947, are of interest: "Our production of oil in England in 1946 has, I regret to say, again declined by some 16,000 tons. Six further areas have been drilled during the year without finding oil. The search for additional structures continues."

The main portion of the production has been from the Eakring field, followed by Kelham and Caunton and then the shallow wells at Formby.

The crude is greenish brown in color and is of a mixed-base type. The specific gravities of the crude from the Eakring and Duke's Wood domes vary slightly in the different sands and between the domes.

Sand	Eakring	Duke's Wood
B sandstone	0.853	0.863
D sandstone	0.828	—
Rough Rock	0.848	0.861
Longshaw Grit	—	0.857
Chatsworth Grit	0.837	0.862

The specific gravities of the crudes from Kel-

Stores yard in Eakring field. Angle Iranian Oil Co., photograph.

ham Hills and Caunton are somewhat higher than the previous ones:

Sand	Kelham Hills	Caunton
Upper Grit	0.892	0.880
Middle Grit	0.880	0.870

The motor and aviation spirits are mixed types with naphthenic constituents predominating, thus giving high octane value. There is a considerable wax content, more than double the average Mid-Continent crude, and the sulfur content is low. Standard methods of manufacture give lube oils of high grade.

A typical analysis of crude from Eakring No. 1 is as follows:

	Rough Rock	Lower Producing Sands
Specific gravity @ 60°F	0.848	0.828
Distillation		
I. B P. °C	57°	37°
Percent vol. to 100°C	3.5	8.0
Percent vol. to 200°C	21.0	27.0
Percent vol. to 300°C	35.0	46.0
Total distillate, percent	36.5	46.0
Residue, percent	61.5	50.5
Loss, percent	2.0	3.5
Distillate Sp. Gr. @ 60°F	0.778	0.770
Residue, Sp. Gr. @ 600°F	0.892	0.884
Sulfur, percent	0.18	0.07
Pour point, °F	—	50°
Temperature at which wax deposition commences	85	80
Viscosity at 70°F C. S.		15.09
Viscosity at 80°F. C. S.	—	8.97
Viscosity at 100°F C. S.	—	5.33
Viscosity at 120°F C. S.	—	4.27

It would appear that this shallow accumulation is in process of continual replenishment, judging from the fresh nature of the oil, its high content of light constituents and its gas content. The analysis of a typical sample of Formby oil is:

Specific gravity at 60°F	0.8395
Distillation test:	
I B. P. °C	73
Percent Vol. to 100°C	2.0
Percent Vol. to 200°C	22.5
Percent Vol. to 300°C	46.5
Total distillate 300°C	48.5
Residue, percent	51.0
Loss, percent	0.5
Distillate Sp. Gr. @ 60°F	0.7875
Residue Sp. Gr. @ 60°F	0.8875
Sulfur, percent	0.34

Further search is being made for the ultimate source of the oil, and deep drilling is in progress. The first deep drilling is now down to 6,848 feet. When commercial production was first attained, the crude was shipped to the Grangemouth refinery of the Anglo-Iranian Oil Co. by railcar, where it was processed to produce a maximum percentage of motor spirit and DERV. Toward the end of 1941 it was decided to change the location of this work, the considerations which led to this being the question of transport under war conditions and the better economic use of the crude, owing to its suitability for the production of high-grade lubricating oils and paraffin wax.

Operations, by arrangement with the Petroleum Board, were therefore transferred to the refinery of Lobitos Oilfields, Ltd., at Ellesmere Port, Cheshire, which is fully equipped for the manufacture of high-grade lubricants and waxes by high-vacuum distillation, and solvent and dewaxing processes. The crude was shipped to the refinery in rail cars by a special train made up of 38 cars, a haul of just over 500 tons of oil on one train.

During the period 1942-45, the following were made from English crude in this refinery:

Product	Tons
Motor spirit	47,600
White spirit	18,300
DERV	107,900
Lubricating Oils	30,000
Paraffin Wax	4,300

These products played their part in fueling and lubricating war machines and incidentally saved a considerable amount of tanker tonnage.

As mentioned previously, the only company now holding licenses in Britain is the Anglo-Iranian Oil Co., so any future prospects rest on its work. At present in addition to the deep drilling in progress at Formby, the company has seismic parties recently working in Derbyshire, Staffordshire, Yorkshire, Lancashire and Shropshire, while gravity and magnetic surveys are being carried out in Southern England generally, the present location being in the Thames Valley.

Use is being made in these investigations of the electrical (tellurgic) method first developed in France, and a party of French geophysicists has been brought over to help in this survey. The object is to measure variations in the electrical conductivity of the soil, and possibly of underlying formations. The procedure is to insert two metal electrodes into the ground at distances about half a mile or so apart, and then to connect them through a cable and current measuring appliance. The electrical circuit is completed through the ground as in the earth-returns type of telephone circuit, and natural variations in the electric potential provide the motive force. To be of value for underground exploration it is necessary that good conducting material should be encountered at depth. In both this method and that of magnetic surveys, fluctuations with time, due to sun spots and other causes, make it necessary to maintain fixed "reference stations" in the same area against which the local variations, which are the object of measurement, can be compared.

Experience gained in Nottingham has shown that where a favorable conjunction of all the factors of reservoir, adequate cover rocks and anticlinal structure, can be found, there is a reasonable prospect of oil discovery, and attention has been directed to other parts of England where conditions comparable to those in Nottinghamshire and Lincolnshire may be found. One of the great geological unknowns in Britain is the nature of the Palaeozoic structure and stratigraphy in an extensive area of the Southern Midlands, a rectangular area bounded by the towns of Bath, Worcester, Rugby and Reading at its four corners. In this large area, only two borings at Batsford and Burford have penetrated the Mesozoic to reach its base; the former drilled through 254 feet of coal measures and then penetrated into Silurian; the latter drilled 226 feet of coal measures and was suspended without reaching their base. The southern part of this area is probably the most favorable for oil discovery. The objectives would be anticlines in the Millstone Grit and Carboniferous Limestone, where a sufficient cover of coal measures has been preserved. A folded belt of Carboniferous rocks extends from South Wales, through the Mendips, through Kent into Northern France, and although the exposed folding in the Mendips is too severe for the possibility of oil preservation, there is a possibility that further east formations may be favorable.

A general consideration of the structural pattern of the zone in the Bath-Bristol coalfield north of the Mendips encourages the belief that the southern half of the coalfield may extend considerably eastward. Geophysical surveys of this region have been commenced, rising in the first place in a gravimeter, to be followed later by seismic surveys. Whether or not targets sufficiently promising to justify drilling will emerge from this work cannot yet be forecast. If the possibility of oil discovery can be demonstrated, then the possibility of hitherto unknown coalfields in this area must also be conceded.

Still further east, in the extension of this area to the Essex coast, there are also possibilities. A well drilled for water at Willesden in 1912 penetrated probably Devonian strata underneath Gault and encountered small but definite oil shows, and as a result the possibility of the occurrence of oil in pre-Carboniferous rocks must not be neglected. Most of the Palaeozoic rocks encountered in borings in the London area have been referred to the Old Red Sandstone of Devonian. Reexamination of samples from a boring at Fobbing, north of the Thames Estuary, in Essex, have led to the conclusion that the rocks penetrated and hitherto regarded as Cambrian, are not older than Middle Devonian, and may possibly be Lower Carboniferous. Therefore, it is possible that Lower Carboniferous rocks or perhaps even Coal Measures, may underlie the Cretaceous in parts of Essex.

The thorough geological investigation which has been made of the Midlands has had other results in addition to the production of oil at Eakring, in that it has proved the existence of hitherto unknown coalfields and marked the extension of others already known, having a bearing on the amount of coal reserves.

Under the present organization engaged in the search for oil in England, it is reasonable to predict that, if further deposits exist, they will be located and brought into being.

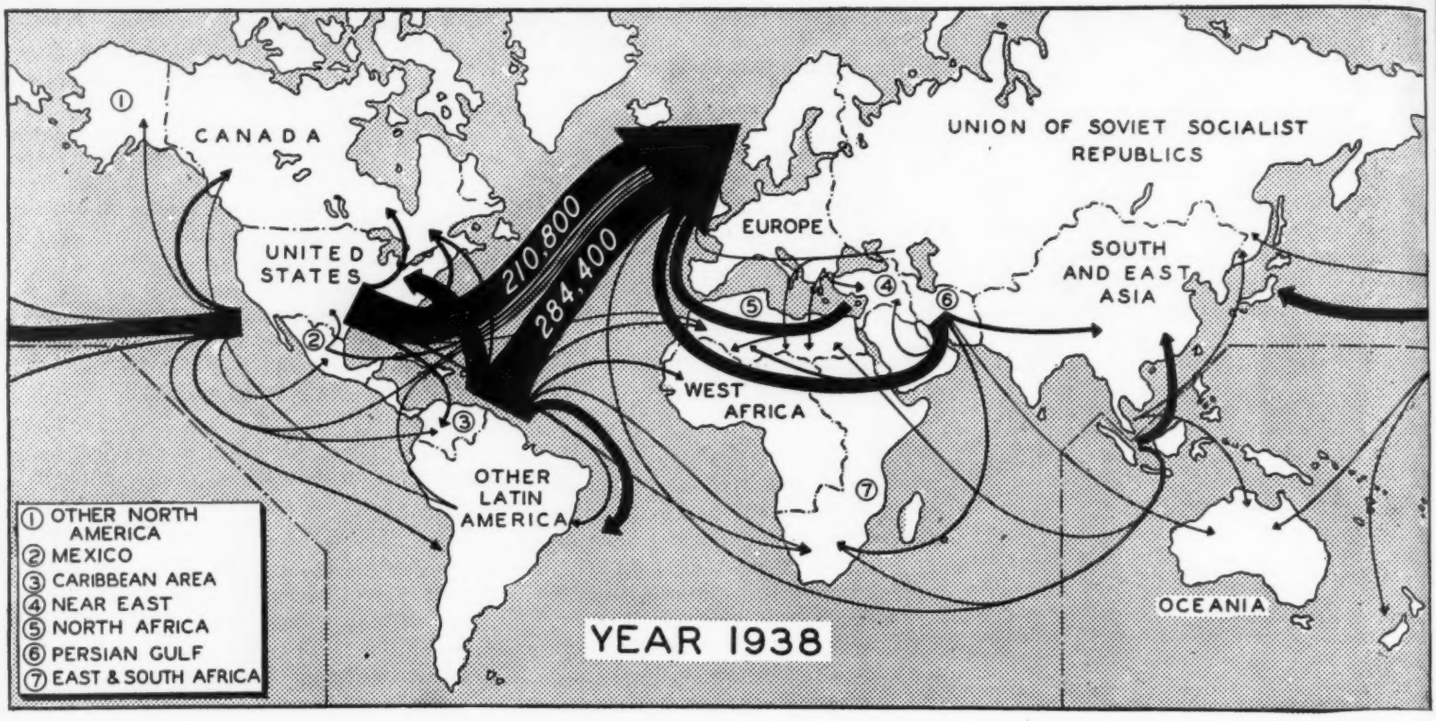


Fig. 1. Intercontinental flow of petroleum and its products in 1938. This chart and Fig 2 on the opposite page are reproduced through the courtesy of the Co-ordination and Economics Department of the Standard Oil Co. (N. J.)

INTERNATIONAL OIL FLOW CHANGING

HISTORIC currents of international oil trade are changing today as the United States becomes a net importer of petroleum after oiling two world wars in a quarter of a century. The flow of oil from the new world to the old is dwindling and within the next four or five years will be cut to half the prewar level with the ultimate prospect that the eastern hemisphere eventually may become selfsufficient.

In 1938 the Eastern Hemisphere produced 1,362,000 barrels of crude daily and consumed 2,050,000 barrels of oil and products. The Western Hemisphere made up the deficit by shipping in 688,000 barrels of petroleum and its products. Fig. 1 is a flowchart reproduced from the July, 1944, issue of WORLD PETROLEUM indicating the main channels of flow in 1938. In that year the United States was exporting 380,000 net barrels of crude and products to Europe in addition to substantial quantities to Canada and Africa.

Figure 2 is a chart showing the intercontinental flow of oil in 1946 which permits a quick evaluation of changes between the first postwar year and the last prewar year. The Western Hemisphere still was supplying 627,000 barrels of petroleum to meet Eastern Hemisphere needs in 1946 but the source of this oil on net balance had shifted largely from the United States to Latin America. United States net exports were down 336,000 barrels daily or 88 percent from prewar. Latin American production doubled between 1938 and 1946, reaching 1,425,000 barrels daily last year. Since Latin American demand was only 600,000 barrels daily there was an exportable surplus of 800,000 barrels daily for consumption in North America and the Eastern Hemisphere.

War devastation kept the East Indies out of the exporting field in 1946 so that the Orient and Oceania were dependent on the Middle East for a large part of their supplies. California exports virtually disappeared because of the lack of a surplus over domestic requirements on the West Coast of the United States. In 1938 California had shipped 134,000 barrels of petroleum products per day to Asia and Oceania and by 1946 this was down to about 52,000 barrels daily, a drop of 61 per cent. East Indies shipments to Asia, Africa and Europe in 1938 had been about 90,000 barrels daily and in 1946 were reduced to virtually zero.

It was fortunate for the needs of the Eastern Hemisphere in the immediate postwar period that production in the Middle East was developed so extensively between 1938 and 1946. In 1938 this area supplied 230,000 barrels of petroleum and products to Europe, Africa and the Far East.

By 1946 the exportable surplus on the Persian Gulf and in Iran and Iraq had risen to about 560,000 barrels daily, an increase of 145 percent during the war.

Considering the proven reserves in the Middle East compared with reserves in the Western Hemisphere it seems clear that the trend established during the war will continue during the next few years. The Eastern Hemisphere has known reserves of 34 billion barrels, about half of the world's visible supply and currently is consuming only 26 percent of the world's production. The United States with 35 percent of the known reserves is producing 64 percent of the current production of oil. Obviously this is a condition which cannot go on indefinitely. The Middle East with known reserves of 27 billion barrels of oil and probable reserves several times as large will be producing largely increased quantities of oil as soon as facilities can be installed. The known reserves in Iran are estimated at 9.5 billion barrels, Iraq 7.5 billions, Saudi Arabia 5 billions and Kuwait 4 billions.

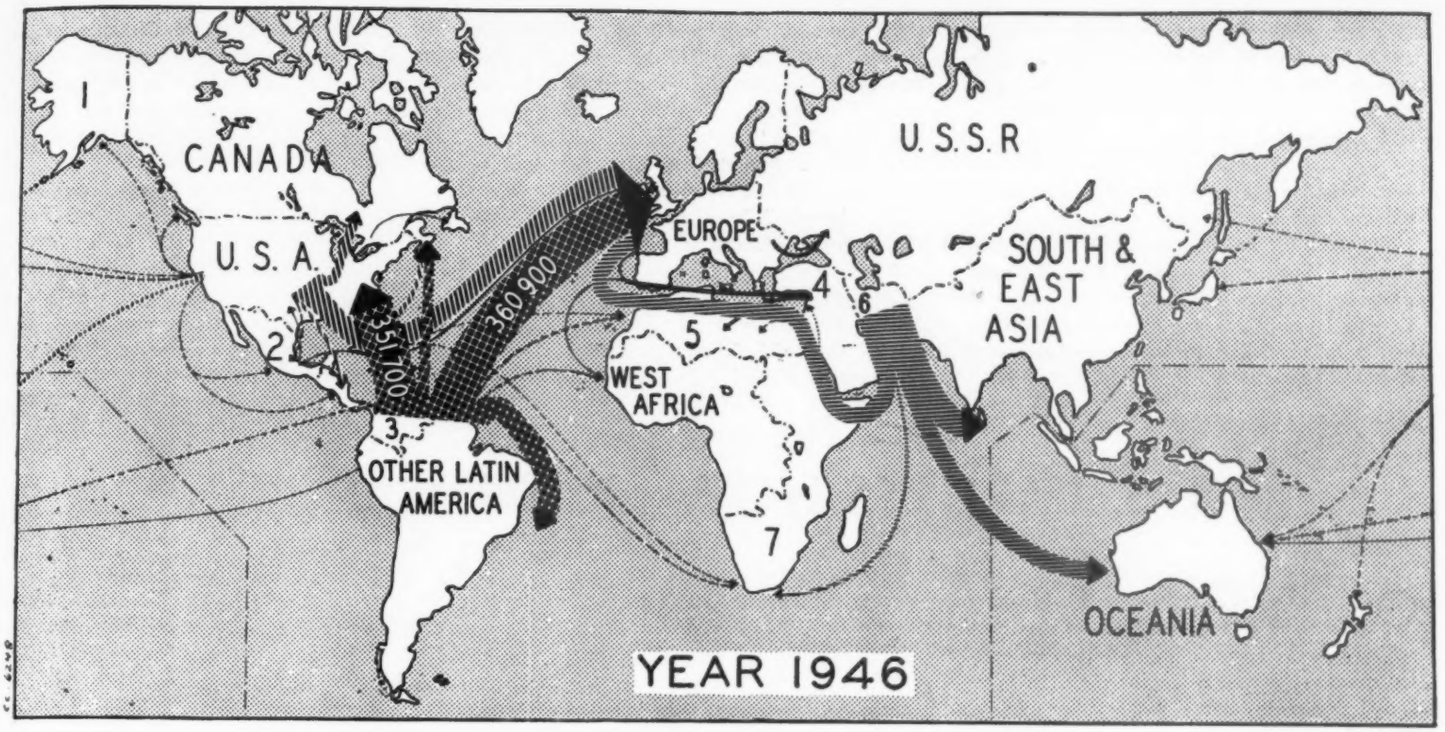
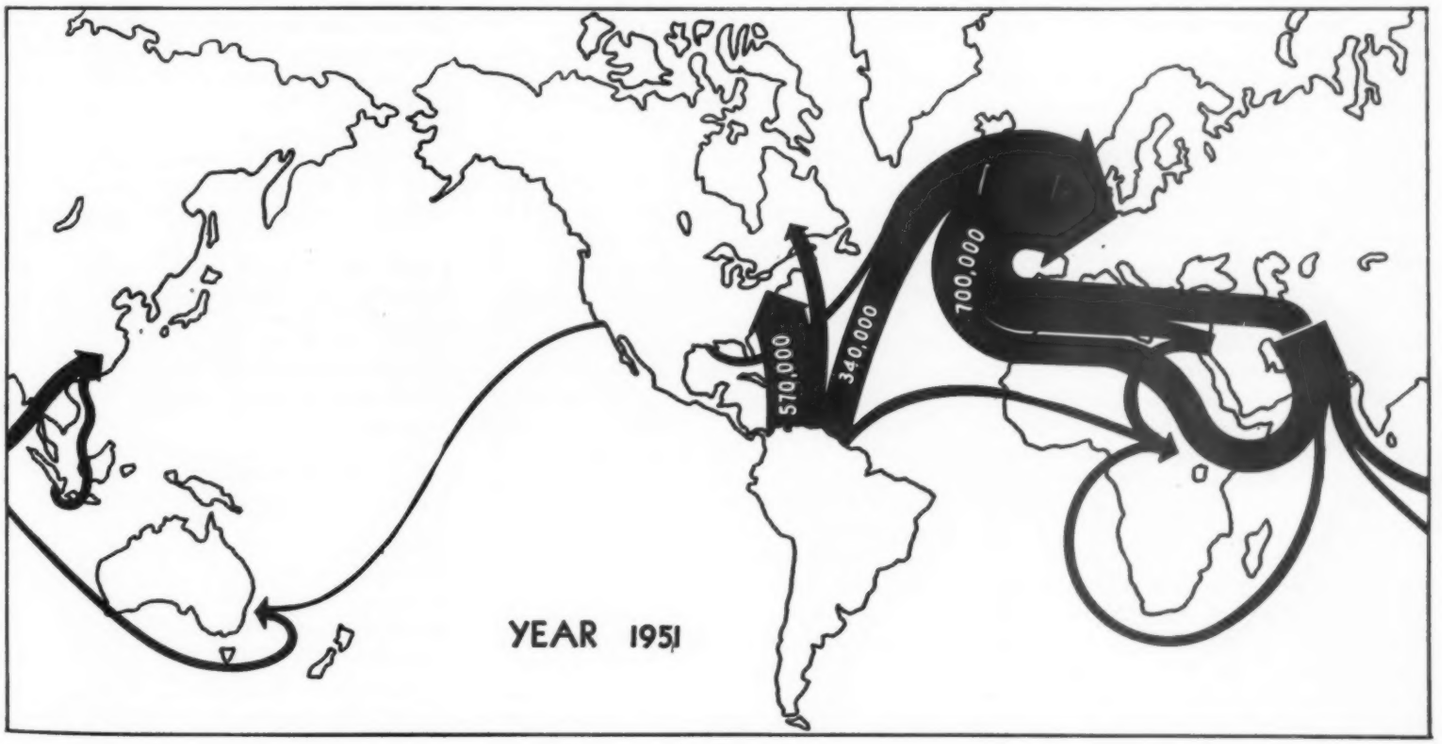


Fig. 2. Intercontinental flow of crude and products in 1946.

As is the case in the United States today the delivery of oil from the Middle East is limited by transportation facilities. From the consumer's standpoint the lack of refining capacity is a second factor preventing largely increased supplies. With the completion of various pipelines and refineries now projected the flow of oil from this area to Europe will double. Most important immediate projects are the 16-inch Iraq petroleum line from Kirkuk to the Mediterranean and the 30-31 inch Trans-Arabian line from Saudi Arabia to the same area. With completion of these projects it will be possible to move 750,000 barrels of oil daily to the Mediterranean. Others from Kuwait and Iran are projected for later construction. On the assumption that the Trans-Arabian and Iraq Petroleum Company lines will be completed as scheduled and that various refinery building projects in Britain and in the Mediterranean area will be completed without undue delay Figure 3 has been constructed. This attempts to pic-

Fig. 3. Estimated intercontinental flow of crude and products in 1951.



ture the probable intercontinental flow of oil in 1951. Estimates of various authorities on probable consumption as well as refining and transportation capacities were taken into consideration in preparing the chart.

In this chart it is assumed that world oil demand will approximate 9.9 million barrels daily in 1951, about 9.4 million barrels daily outside of Russia. Western Hemisphere demand is expected to be about 7.1 million barrels daily and Eastern Hemisphere demand about 2.8 million barrels daily including Russian demand estimated at 500,000 barrels daily.

Unless some very large new fields are discovered in the United States within the next year or so it is anticipated that this country will continue as a net importer of oil on an expanding scale. This probably will approximate 450,000 barrels daily in 1951. Imports from Latin America are estimated at 750,000 barrels and exports at about 120,000 barrels daily. Latin American exports to Europe are estimated at 340,000 barrels daily with lesser volumes to Canada and Africa. On balance it is estimated that net imports from the Western to Eastern Hemispheres will average 367,000 barrels daily in 1951, a reduction of 42.7 percent from 1946.

By 1951 the Near East and Persian Gulf producing areas may be exporting more oil than Latin America. The total may well exceed 1.2 million barrels daily of which more than 700,000 barrels would flow to Europe. While producing operations in the Far East may bring output up to 250,000 barrels daily the nearby demand will be such that the Persian Gulf will still find a substantial outlet in Australia, India, and far eastern Asia. From 1951 onward the trend suggested is likely to continue until the Eastern Hemisphere loses its dependence on the western world for the first time since the close of the 19th century.

U. S. IMPORTS NOW EXCEED EXPORTS

OIL trade of the United States with other nations, both import and export, has been subject to wide fluctuations during the past quarter century. These swings at times have reflected changes in internal and at other times in external conditions. For a period much longer than this, however, the country has been a purveyor of crude oil and to a much larger extent of petroleum products to all parts of the world. Americans indeed introduced these products in many countries and developed their use by progressive salesmanship. While the production of oil has been vastly extended since those early days and many refineries have been built in other parts of the world to share in supplying international markets, contacts then made have been preserved in many instances, and importing countries still rely upon the United States to provide a good part of the products they need.

World War I created the first heavy demand for petroleum for military use, although the quanties required were only a fraction of those consumed in the second great world struggle twenty-five years later. Most of the oil that helped to sustain the Allies in that earlier conflict came from the United States, and its provision was made possible only by united action by the members of the American petroleum industry and by some self-sacrifice on the part of the American people. Directly following the close of the war came the phenomenal expansion of the automotive era which multiplied the demand for motor fuel at a rate that could not have been met except for the rapid adoption of the cracking process which had just been introduced and which shortly made it possible to double the amount of gasoline recoverable from a barrel of crude.

During the early twenties when both domestic and export demand were increasing rapidly, dire predictions were being made of the early exhaustion of the petroleum resources of the United States. The industry had not geared itself to the higher rate of consumption that had developed, and it was pointed out that known reserves were sufficient only for a dozen to fifteen years' requirements. Under these circumstances Americans were encouraged to develop production outside the country, and imports rose to unprecedented levels. In 1922 imports which had varied from 12 to 18 million barrels yearly before the war, rose to 135 million barrels, comprising 19 percent of the total supply. This figure was not to be reached again until 1946. Practically all of this record import was supplied by Mexico, then at the apex of its output. During succeeding years Venezuela displaced Mexico as the chief foreign source of supply. By 1922 it was sending to the United States 34 million barrels of crude as compared with 12.6 million each for Mexico and Colombia. In that year total imports amounted to 108 million barrels or nine percent of the total supply.

In the second half of this decade the discovery of very large fields in Oklahoma and Texas reduced the demand for imports, which fell to 71 million barrels in 1927, rising again above 100 million with the upswing in demand in 1929. The depression years of the early thirties, coinciding with the rising flood of East Texas oil, cut imports of crude to 32 million barrels in 1935 and to 26 million in 1938. Meanwhile imports of products rose from 20 million in 1935 to 28 million in 1938, temporarily exceeding the volume of crude. From 1938, except for the war years 1942-43 when shipments from the Caribbean were interrupted by U-boat raids, imports have continued to grow. In the final quarter of 1946 and the early months of 1947 they exceeded exports, making the United States a net importer on balance. For the first six months of 1947, imports have averaged 472,000 barrels daily, while exports have been roundly 420,000 barrels daily.

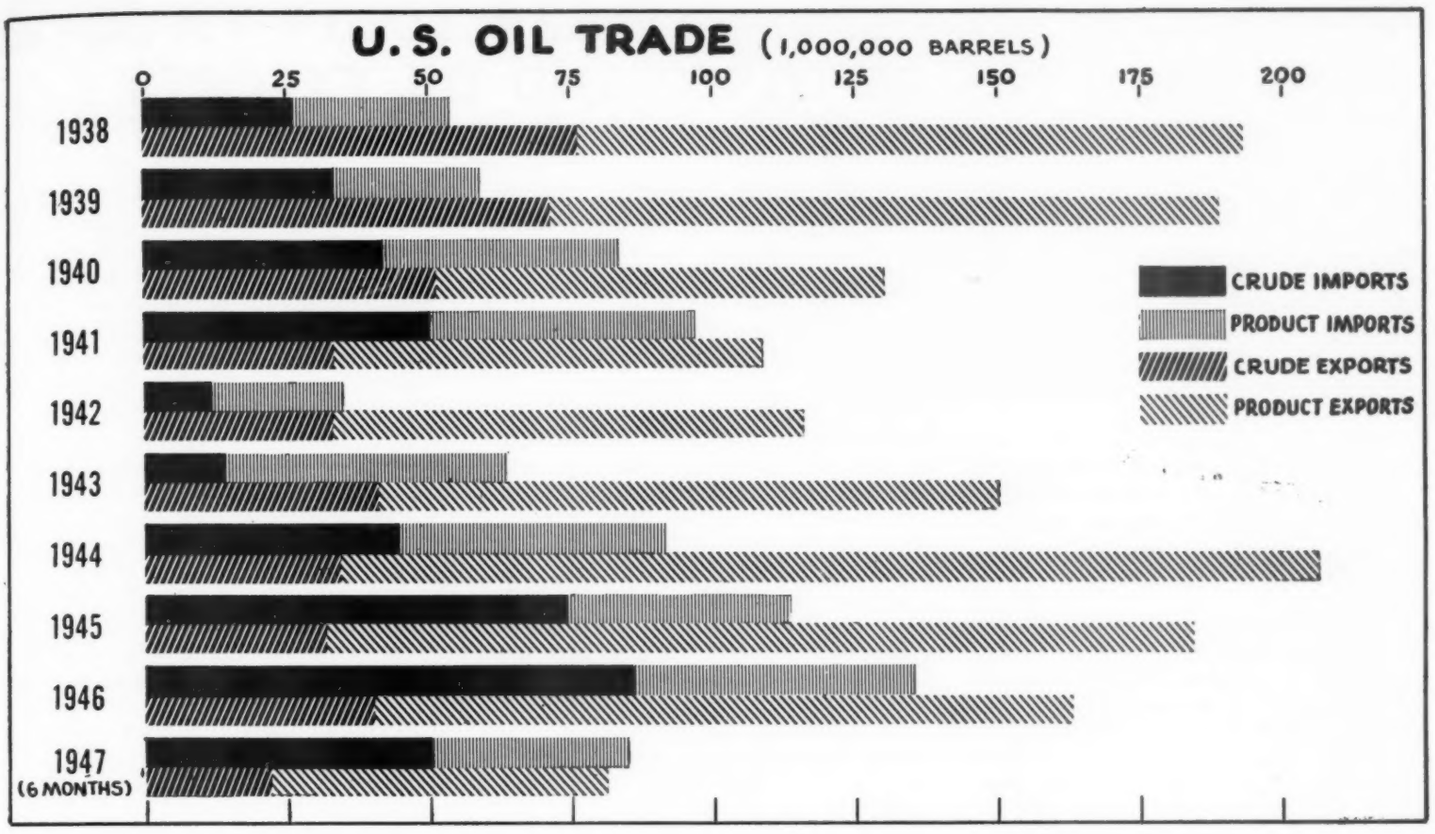
The noteworthy change in imports is the great increase in the proportion of crude in the total. In the prewar period there was a fairly even division between crude and products, and in the two war years 1942-43, products exceeded crude by nearly three to one. In 1945 and 1946, however, crude constituted 65 percent of the total import. Residual fuel oil made up roundly 90 percent of the refined products imported. Consumption of residual fuel oil in 1946 was less than in the two preceding war years but showed an increase of 25 percent over 1941.

While the recent rise in imports has been the cause of some uneasiness among producers in certain sections of the country, it appears to be but a repetition of previous movements at times when total demand has risen more rapidly than domestic production, as in the early twenties, the late thirties and again in the two years since the close of the war. In general, imports have been drawn upon to supplement rather than to replace domestic production and have consisted mainly of crudes especially suited for processing into products for which domestic crudes are less adapted or less readily available. Similarly the finished products imported are as indicated the heavier grades of fuel oil, while most of the crude produced in the United States can be more profitably employed in the making of lighter end products.

Export trade in general has been subject to less fluctuation than import receipts. With the exception of a temporary recession during the depression years of the early thirties, it expanded gradually between the two world wars as shown by the following averages for five-year periods in thousands of barrels:

	Yearly Average, Thousands of Barrels	
Years	Exports	Imports
1921-25	96,340	107,439
1926-30	150,165	91,787
1931-35	115,302	61,821
1936-40	165,288	62,276
1941-45	153,499	80,429
1946	151,060	135,033

Finished products have been consistently much in excess of crude in the division of exports. In the



decade following World War I crude provided 12 to 16 percent of all exports. In the years following 1932 there was a marked upswing culminating in a top figure of 77,254,000 barrels in 1938, when crude formed nearly 40 percent of total exports. At that time Japan and Germany were accumulating stocks for military use and greatly increased their purchases from the United States, both of crude and products. Canada regularly holds first place as a purchaser of crude, some of its larger refineries being fed by pipe lines leading across the border from the United States.

Distribution of finished products is of world-wide range. While the heaviest shipments of gasoline and fuel oil go to the industrial nations of Western Europe, such as the United Kingdom, France and Sweden, lesser quantities are shipped to practically every country except those that have their own refining facilities, while almost the entire requirements of many countries, even those that are producers of oil, in the way of lubricating oil, grease and specialized products are supplied by American companies.

In the flurry that was caused earlier in the year when a tight supply situation forced some Midwestern distributors to put a limitation on deliveries to their customers, sporadic demands for an embargo on all shipments of petroleum and petroleum products were made. These proposals, needless to explain, came from men who were unfamiliar with the oil industry. They were not adopted, and Congress limited itself to extending the life of export control and requiring that export shipments have the approval of the Department of Commerce.

In making forecasts of future conditions of supply and demand, predictions have been made that exports from the United States will decline rapidly within the next few years. It seems altogether likely that exports of crude, already on the decline, will decrease still further as refinery construction in outside countries expands, but the export trade in petroleum products is so firmly established and holds such an important place in the industrial life of many countries that it promises to maintain substantial proportions for a long period to come, even though a gradual increase in imports may be necessary to permit its continuation. To put an embargo on all exports would have a disastrous effect, for example, on Canada which, as has been shown, is dependent to a large degree on imports from the United States. Similarly, to prohibit the shipment of American products to other countries of the Western Hemisphere, to Europe, Africa and the Pacific area, would inflict serious injury upon the importing countries which could not fail to be reflected upon the economy of the United States itself.

It cannot be overlooked that the export of petroleum products has been and still is one of the mainstays in supporting the favorable international trade position of the United States. While the country's imports consist almost exclusively of crude and low-priced products, its chief exports are products which bring in a much larger return. In 1946 the value reported for all export petroleum products was above $425,000,000. If deduction is made of the entire cost of imports during the same year, there remains a favorable balance of some $275,000,000, an important factor in the nation's balance sheet.

U. S. OIL EXPORTS

(Thousands of Barrels)

Year	Crude	Products	Total	Daily Average
1938	77,254	116,639	193,893	531
1939	72,076	117,187	189,263	518
1940	51,496	78,781	130,277	357
1941	33,238	75,533	108,771	298
1942	33,834	83,073	116,907	320
1943	41,342	108,615	149,956	411
1944	34,238	173,365	207,603	568
1945	32,998	151,075	184,073	504
1946	40,750	122,794	163,544	448
1947 (6 mo)			76,590	422

U. S. OIL IMPORTS

(Thousands of Barrels)

Year	Crude	Products	Total	Daily Average
1938	26,412	27,896	54,308	149
1939	33,095	25,965	59,060	159
1940	42,662	41,089	83,751	226
1941	50,606	46,536	97,169	264
1942	12,297	23,669	35,966	98
1943	13,833	49,579	63,412	174
1944	44,805	47,451	92,256	250
1945	74,337	39,282	113,373	311
1946	86,066	48,967	135,033	370
1947 6 mo)	50,870	34,800	85,670	473

MEXICO MOVES TO EXPAND OIL EXPORTS

HAVING raised oil production to a level where it is more than sufficient to cover internal requirements, Mexico is now concentrating special attention on the upbuilding of exports. This is in accordance with the government's double-barrelled policy of stimulating foreign sales while at the same time drastically limiting the importation of commodities, especially those that can be classified as luxuries.

Only a few weeks ago President Aleman decreed a ban on the import of a long list of articles, including automobiles, refrigerators, radio sets and other things that are considered to belong in the luxury class. At the same time tariff rates were raised on various kinds of goods in order to discourage purchases. The purpose in view is to curb the outflow of currency which was rapidly depleting the country's monetary stock. So serious had this become, according to official statements, that if not slowed down, it would have become impossible, even with aid from the United States, to maintain the peso-dollar rate at 4.85 where it has been held since shortly after the commencement of war in Europe in September, 1939.

With the drop in mineral exports since the close of the war Mexico no longer has the large balance of dollar exchange which it formerly enjoyed and conseqnently has a stronger incentive for building up other foreign sales. The attitude of the government toward oil was explained in a speech which the President made in the course of an inspection tour of Vera Cruz. "Formerly," he said, "we exported essentially silver and oil. But now that the white metal is passing through a difficult period with a tendency toward a drop in price and demand, grave consequences are portended for Mexico as the world's largest producer of silver. In these circumstances we are increasing the sale of oil and seeking throughout the national territory new deposits in order to have more supplies available for such use. Oil is the only product with which we can defend our exportation and consequently our money."

Expressing the same thought, Senator Bermudez, director general of Petroleos Mexicanos, told the Rotary Club of Mexico City: "The greatest concern of Pemex since December 1 of last year has been to increase its exports, for there is nothing better than that to level our trade balance and raise the value of our money." Suggesting that first consideration should be given to the United States so far as that country had need of Mexican oil, he said: "Mexico, neighbor of a powerful and friendly country, has the obligation to supply it with her oil, in peacetime to foment industry and in wartime, should it unfortunately come again, for military use. Oil must be like civilization, not the private property of a people but for all."

In a press conference the head of Pemex assured newsmen that stocks of motor fuel in Mexico were 110 million liters and that supplies of "Mexolina," the high-grade gasoline dispensed by Pemex, ample for all needs were on hand in filling stations. Reports of shortages had been exaggerated as the company fills all orders for products promptly as received. The only exception is that the task of supplying Pacific Coast points remains difficult because of the lack of sufficient transportation. The result is that only 52 percent of the needs of that area are covered by Mexican products, the remainder being supplied by imports. Sonora, Sinaloa and a large part of Chihuahua are dependent upon imports. Senator Bermudez expressed the hope that the railroads would soon be able to provide the facilities needed to service that section of the country adequately.

According to records maintained by the Ministry of Finance, production of oil in Mexico has risen from a daily average of 127,000 barrels in 1946 to 164,000 in May of this year. Production for the twelve months of 1946 totaled 42,500,000 barrels. The output for 1947 was estimated earlier in the year at 50,500,000 barrels, but in view of the rise that has taken place during the first half of this year, the latest calculation put the probable outturn at 56 million barrels. Current domestic consumption is about 107,000 barbels or around 40 million barrels for the year, so that even the earlier estimate would allow sufficient margin for the export of 11 million barrels which is the goal set by Pemex.

In order to keep production ahead of the combined requirements of the domestic and export markets, the work of exploration and the expansion of other facilities of the industry are being pushed as rapidly as conditions permit. Surveys are being made of 64 structures in accordance with plans prepared by a corps of geologists. Drilling of 110 wells is under way in various parts of the country. This work is being performed by foreign contractors because of the lack of equipment in Mexico. Installations are nearing completion for the recovery of gas as Poza Rica and utilization of products obtained from it. This gas has been flared for years in the absence of any means for putting it to use and is declared to represent a loss of 100,000 pesos daily. A gas pipeline will be built between Poza Rica and Mexico City, a distance of 252 kilometers. Its construction requires 24,000 tons of 20-inch pipe which has been ordered from Altos Hornos de Mexico, the iron and steel works at Monclova, Coahuila. Delivery is soon to be taken of 1,000 tons and the rest will be delivered in monthly lots of the same amount, so that by September there should be 3,000 tons on hand. Apart from this order negotiations are under way in the United States for pipe to round out the requirements.

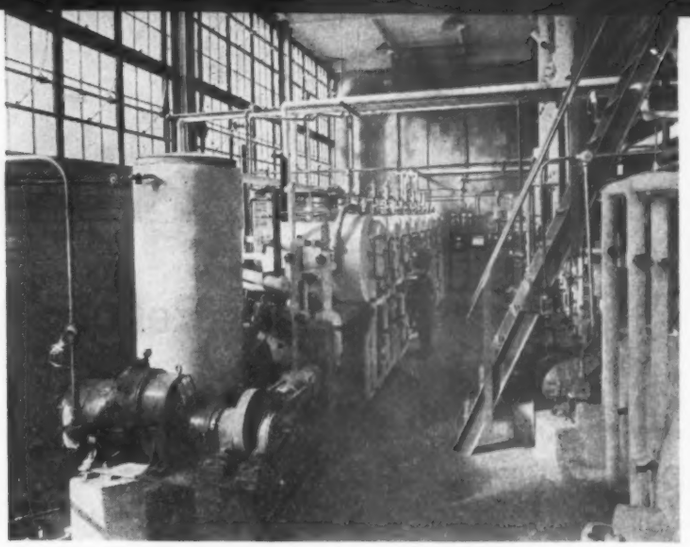
Twenty kilometers of pipe have been laid on the line between Poza Rica and the refinery Pemex is building at Salamanca, Guanajuato. Another 87 kilometers of 12-inch pipe has been shipped from the United States for this job, because Altos Hornos lacks sufficient capacity to produce the two sizes of pipe. Establishment of the refinery at Salamanca was decided upon because of the strategic importance of the location in serving a wide zone of midwestern Mexico. Later a pipeline will be built from Salamanca to Guadalajara, the Jalisco capital and Mexico's second largest city, in the far west, where a refinery will be built at some time in the future.

Senator Bermudez has also stated that Pemex's tanker fleet will soon be reinforced with new and reconditioned units to be used in better servicing the home market. Exports, he intimated, must be handled as far as possible by the buyers' own tankers. He said that $500,000 (U. S.), perhaps more, has been estimated as the cost of reconditioning the tankers Cerro Azul, 9,600 tons; Tampico, 9,700 tons; Minatitlán, 11,800 tons; and Toteco, 10,000 tons. Pemex's oldest tanker, the 18 de Marzo, is in good condition and so is the Panuco, 10,000 tons.

Exports have been increasing steadily and according to Pemex have nearly tripled in value during the past six months. In June they amounted to $2,311,000 (U. S.) as compared with $800,081 in December last. Shipments have been made not only to the United States but also to France and Italy and, in smaller quantities, to other countries. In view of the strong demand for petroleum products that exists in all parts of the world, Mexican authorities are confident that the country's oil exports can be raised to a point where they will go far toward restoring a satisfactory balance in Mexico's foreign trade.

To facilitate the movement of oil both to home and foreign seaports, Pemex has assigned engineers to participate in the work of harbor improvement which the Ministry of Marine is pushing at various points. Its engineers are taking an active part in the port development which the Ministry is carrying out at Mazatlan on the Pacific Coast.

SOCONY PILOT PLANT PERFORMS ALL LUBE PROCESSING STEPS



Duo-Sol unit in the new lubricating oil pilot plant of the Socony-Vacuum Oil Company, Inc at Paulsboro, N. J.

COSTS of crude evaluation at Socony-Vacuum Oil Company refineries will be reduced to a fraction of their former level in a new lube pilot plant now nearing completion at Paulsboro, N. J. Whereas a complete lube story of a new crude previously cost several hundred dollars per gallon of oil produced for testing, the new Socony pilot plant will operate at a cost on the order of $25 per gallon of finished oil. More important perhaps than the reduction in costs per gallon is the fact that the new plant will produce large enough samples for adequate field tests under service conditions as well as the usual laboratory tests.

A second function of the new pilot plant will be to evaluate new solvents, new processes or variants of processes. Tests can be run which are adequate to prove and develop a new process to the commercial stage.

Socony-Vacuum research activities are divided into three main groups. A production laboratory for the study of field methods is operated by Megnolia Petroleum Company, southwestern subsidiary at Dallas, Texas. This laboratory employs about 150 technologists. A second branch is the technical service division at Brooklyn with about 300 employees engaged principally in fitting Socony products to the diverse requirements of the industry. The third and largest is the research and development division with 850 employees eat the growing laboratories adjacent to the Paulsboro refinery.

The Paulsboro laboratories now occupy a 28½-acre site with 26 buildings. Activities are divided into six divisions: automotive, chemical, process development, light products, physics and lubes. The physics division is one of the newer additions, and the lube pilot plant is the newest of all, actually not yet complete in all particulars.

With about 10 percent of the floor space at the Paulsboro laboratories, the new lube pilot plant occupies a building 228 feet long and 30 feet high. It has its own tank farm with a multiplicity of tanks for crudes, solvents, wash naphtha and finished or intermediate oils. Suitable manifolding is provided so that the 10 miles of lines may be purged with naphtha to prevent contamination of stocks for careful work. The nearby refinery is handy in that it can utilize slop accumulations and provide utilities.

Crude to be evaluated is pumped from storage to one of the five gas-fired batch stills where light products are stripped off and wax distillates and residums segregated. Steam is used in the distillation, and a vacuum pump and a vacuum jet pull 10 to 178 millimeters of mercury absolute. No continuous stills are available at the moment but will be built soon.

Following distillation, the various cuts may be subjected to all modern methods of lubricating oil manufacture. Agitators are available for acid treating, caustic and water washing. These agitators do double duty, being employed also as blending tanks being in the preparation of finished oils. Solvent treating equipment is available for treating 12 to 15 gallons per hour with the various single solvents for extraction and dewaxing and a Duo-Sol unit. The dewaxing step includes chilling and filtration. Final finishing consists of clay percolation or clay contacting as may be desired.

Socony engineers who designed the pilot lube plant took special care to relate the operation to commercial conditions found in the field. Particularly in the solvent sections, the design is such that various plant efficiencies may be simulated. To accomplish this, a series of stage mixers and settling tanks was installed instead of a tower. In this way results from older equipment may be duplicated as well as results from the newest and most efficient plant in the Socony group.

The Duo-Sol unit is a nine-stage continuous extraction system using counter flows of charging stocks and solvents. The various stage units are so manifolded that the number of extraction stages in use at any one time may be varied over a wide range. The Duo-Sol unit may be operated at temperatures up to 165°F and 500 psi.

Single solvent work with any one of the solvents, such as furfural, phenol, chlorex, nitrobenzine, etc., is done in an eight-stage apparatus capable of processing 12 gallons per hour at temperatures ranging from 30 to 400°F. Number of extraction stages in this unit may be varied as in the Duo-Sol unit.

Propane deasphalting equipment is not yet installed but will be ready for early operation. Benzol ketone is the solvent employed in wax removal. Refrigeration is supplied by an 18-ton refrigeration unit. Waxy oil-solvent blends are chilled in a Vogt scraper surface chiller which was handed down from actual commercial use at a Socony refinery and was installed before the walls of the laboratory had been completed. The wax is removed by an Oliver rotary filter which may be used for either conventional or pre-coat dewaxing. Batch dewaxing is possible in a blanket-type filter. Both may operate at —35°F.

Solvent recovery is accomplished in nine batch-type steam stills. Smallest of these takes a charge of five gallons, the largest 175 gallons.

To avoid contamination or excessive line purging, much of the oil in process is transferred in the laboratory in portable tanks. Steam outlets are available at many points in the laboratory, and Socony engineers have designed a small steam heater which will raise the temperature of a barrel of oil to 250°F in a very few minutes.

In addition to the usual inspection tests on conventional or experimental oils, the automotive section of the Paulsboro laboratories conducts motor tests. Gear lubricants are tested in dynamometer loaded gears and motor oils in gasoline or diesel motors. If laboratory engine tests are satisfactory, the oils then are sent out for motor fleet tests under various service conditions in all parts of the country.

Thomas P. Simpson is director of the research and development laboratories at Paulsboro. His immediate assistants in charge of various phases H. S. Snyder, R. Rea Jackson, T. A. Petry and of the work include Dr. A. A. O'Kelly, George Harold C. Myers.

ITALIAN INDUSTRY

Preparing Return to Private Operation

PUBLICATION in the Gazzetta Ufficiale of July 17 last of a ministerial decree requiring full liquidation of the CIP administration by the end of next December gives official assurance that from January 1, 1948, the Italian oil industry will return to private operation. This will follow three years of control by the Comitato Italiano Petroli (Italian Petroleum Board) and seventeen months, from January, 1946 to May, 1947, during this same period, when Italy was supplied with 1,964,000 metric tons of free products by UNRRA.

The program adopted by the Petroleum Board for the final quarter of 1947 provides for a supply of 500,000 metric tons of crude, 7,000 tons of aviation fuel, 3,000 tons of ordinary gasoline, 4,000 tons of kerosene, 27,000 of gas-oil and 650,000 tons of fuel. The interesting figure in this list is the one for fuel oil which is three times the prewar rate and is authorized in an effort to offset in part the serious deficiency in the supply of coal.

During the liquidation period CIP will continue to supervise imports, ocean transport and the reconstruction program. This provides for payment to CIP of a certain proportion of the price of oil products which is applied in part to the costs of management and administration, the remainder going to a fund for the reconstruction of damaged plants.

While the oil companies are busy with plans for extending their operations under the more liberal conditions that will prevail after the exodus of CIP, and are reestablishing their distributing facilities and reconstituting their staffs, it is not to be expected that complete independence will be restored in the near future. The scarcity of dollars and of sterling exchange with which to pay for imports will force the government to maintain restrictions upon the quantities that may be brought into the country. In order to ease the financial drain as much as possible, importation of crude oil rather than products will be favored, and the movement in this direction is proceeding as refineries are being brought back into service or increased capacity. Progress along this line is being speeded up as much as possible by the international companies that have operated in Italy in the past and through agreements between native and foreign companies that are being effected. The plan that probably will be adopted will be to allocate supplies to companies before the war in proportion to the share of the market which each held at that time, but with a certain quantity withheld to take care of newcomers. Several of the latter are planning to enter the field.

Of the companies active in Italy before the commencement of the late war, the most important were AGIP, Italian-financed and operated, Nafta, a Shell subsidiary, SIAP (Standard Oil N. J.), Vacuum (Socony-Vacuum) and Anglo-Iranian. Two of the AGIP refineries, Shell's plant at La Spezia and the Vacuum refinery at Naples have been in operation since early in the year. The SIAP and Aquila refineries are located in Trieste but will continue to serve the Italian market. In addition the ANIC refinery at Bari, originally built as a hydrogenation plant, has been working on crude oil for several months, and a number of Italian refineries of small capacity have been in operation. Refining capacity is still far too low to meet the country's requirements but is being increased as fast as equipment becomes available.

To meet the changed conditions that have been created by the war, agreements have been made between Italian companies and those of foreign ownership. Among such agreements that have been made known are those between the following: AGIP and Anglo-Iranian; AGIP and Sinclair Oil Company; ANIC and Standard Oil Co. N. J.); APRI and Compaigne Francaise des Petroles.

The arrangement between AGIP and Anglo-Iranian Oil Co., Ltd., which has been approved by CIR (Interministry Reconstruction Committee) will insure for ten years a regular supply of 50 percent of the refined products needed by AGIP with provision for a possible increase to 100 percent. The agreement calls also for the delivery annually of a minimum of 420,000 tons of crude to the AGIP refinery at Porto Marghera which is to produce 35,000 tons of lubricants. A new company, IROM, will be established for operation of the refinery. Through this undertaking AGIP will relinquish its refining activities but will continue as a distributor of products. From the viewpoint of the government as well as of AGIP itself, an advantage of this arrangement is that it will provide a crude supply for IROM without the disbursement of foreign currency.

The agreement between AGIP and Sinclair Oil Company relates more particularly to cooperation between the two in exploratory work in Eastern Africa where AGIP conducted preliminary work during the period of Italian control of that area.

It is understood that the arrangement calls for the exchange of technical information and makes available to Sinclair the results of its earlier surveys and contemplates further association in case the exploratory drilling which Sinclair is shortly to begin in the Ogadens territory leads to the discovery of oil.

The agreement between ANIC and Jersey Standard involves the supply of crude to the refineries of ANIC at Bari and Leghorn and the sale of the refined products by SIAP (Standard subsidiary) on the Italian market. This accord is to be considered the basis for further development of relations and may lead to new understandings in the future.

A further agreement was consummated late in July when an arrangement was signed in Paris between Compagnie Francaise des Petroles and the group APRI-DELIOM, by which the French company will receive a 30-percent participation in the project launched recently by the Italian interests for the development of refining and distributing facilities centered at Genoa. The convention is for a period of 20 years. As its contribution to the enterprise, Compagnie Francaise is to supply 600,000 tons of crude and products, presumably of Iraq origin.

Italy's hope is that these agreements and others to follow will build up refining facilities and develop the manufacture of products, sufficient not only to satisfy Italy's needs but also to provide exports to other Mediterranean countries. The reasoning back of this idea is that Italy occupies an advantageous position between the Middle East and Western Europe for the processing of crude and the distribution of products.

Among the companies recently organized is CONIP (Cooperative Society for Petroleum) which is sponsored by the International Cooperative Petroleum Association. Its plans have not been fully made known, but it is reported that it may obtain its supplies through the Consumers Cooperative Association of Kansas City in the United States.

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UNDERGROUND

Compressor installation at Alabama Power Co.—Bureau of Mines coal gasification experiment at Gorgas, Ala. Boiler at left furnishes steam for injection with air by the blower-compressor. U.S. Bureau of Mines photograph.

WHILE optimists are hoping for the best in the way of new oil discoveries in the United States, realists who are not so optimistic are preparing for the worst. The problem of utilizing oil shales is being attacked on a large experimental scale, backed by much federal money, although, in spite of its abundance, shale at present holds no promise of cheap gasoline.

At the same time work is being pushed by both government and private interests to prepare for turning coal into gaseous and liquid fuels. Herein the experimenters are inspired by hopes of accomplishing with coal something which it is not immediately possible to accomplish with shale—a synthetic gasoline that may compete with petroleum gasoline in the current market, or at least a convenient gas from coal that can hold its own in competition with petroleum.

The fact is that under prevailing conditions petroleum in the form of diesel oil, fuel oil and natural gas is narrowing the market for coal. The railroads are buying more diesel locomotives and fewer coal-burning engines; home owners and factories are turning more and more to oil and gas. The coal industry is finding it hard to compete with petroleum fuels either in cost or in practical convenience. Coal is expensive because it has to be dug out of the ground in a difficult and dangerous operation by laborers who are now drawing high wages. And when it reaches the consumer, he has to bear the inconvenience and expense of handling, stoking and ash removal.

There are critics of the coal industry who say that the bad economic position of this industry could largely be improved by imagination and enterprise. Why ship solid coal at a large cost to distant points for conversion into industrial power? Why not convert it into electricity at the pit mouth and ship the power by cable? This is what the Germans were doing prior to World War II, when they were burning half their production of brown coal to drive electric generators at the mine site; and according to figures issued by the U. S. Bureau of Mines, 60 percent of all German power was produced in this way. And lately it has begun to be asked, why dig coal at all, even for conversion into power at the mine site? It is now known that coal can be converted into a fuel gas by dry distillation with less waste than is involved in the usual operations of mining and cleaning, and that the most logical place to do this is in the underground seam of coal itself. No coal would then need to be mined and brought to the surface. Only the gas would come out, to be converted into power on the mine site or be inexpensively transported by pipeline to distant points for industrial and domestic use, and the ash would remain behind. Moreover, the gas would come out as the familiar water gas, or as almost the equivalent of natural gas (depending on the method of operation); in this form it could be converted into synthetic petroleum products just as is now being attempted by application of the Fischer-Tropsch process to natural gas. Leaving out the question of relative cost, which has not yet been definitely settled, this would solve the problem of where to get gasoline when petroleum reserves are exhausted—or become too expensive. It has been estimated that if only 50 percent of this nation's coal reserves were converted into water gas by underground gasification, instead of the present 20 billion-barrel known reserve of crude petroleum, we would have an equivalent available reserve of 3.7 trillion barrels.

The idea of gasification of coal underground has long been developing. The first recorded suggestion came in the early 1860's from the famous Russian chemist, D. D. Mendeleeff, discoverer of the periodic system, whose attention was attracted to the accidental burning of coal seams. He inspected several such instances and observed that the coal was consumed cleanly over a wide area. He conceived the idea that if a coal seam were purposely fired and if the fire were controlled so that much of the coal was subjected to dry distillation under conditions such that a rich, burnable gas should be brought to the surface, it would do away with the traditional mining operations. Mendeleeff had this indisputable fact to go upon: when a fire takes a good hold on a seam

GASIFICATION OF COAL

By Dr. O. W. Willcox

of coal, it will burn to the end if no unusual circumstances interfere. In fact a coal mine fire is extremely difficult to put out; such a fire has been burning for 50 years in an Ohio mine and so far has resisted every measure taken against it.

Mendeleeff was intrigued especially by the social aspects of his idea. He enlarged at length on the theme that the miners would be relieved of a dangerous and laborious operation. He also saw the possibility of using coal seams too thin or too impure for ordinary economic purposes, thus enlarging the available reserve of coal. But the Czarist government of the time was not interested, and the idea went into hibernation.

The well-known British chemist, Sir William Ramsey, brought it out again in 1868, and he designed what he called an underground gas generator (see Fig. 1). Taking their cue from Ramsey, several inventors obtained British patents on variants of the idea. Nothing came of it, and the proposition remained dormant until it was revived by Lenin, the Russian arch-Bolshevist. When he was not dodging the Czarist police, Lenin wrote books and articles showing how he would reduce Marxian socialist to practice. One point on his program was vitalization of Mendeleeff's idea about the underground gasification of coal; over and over again he referred to the social benefits that would follow: the distribution of an inexpensive gaseous fuel over wide area, saving of enormous expenses of transport and freeing coal miners from their laborious and dangerous occupation. After the Bolshevists came to power, Lenin was very busy with other matters, but before his death, he had his idea incorporated in the Marxian program; and about 1930 a commission was organized to put it into execution.

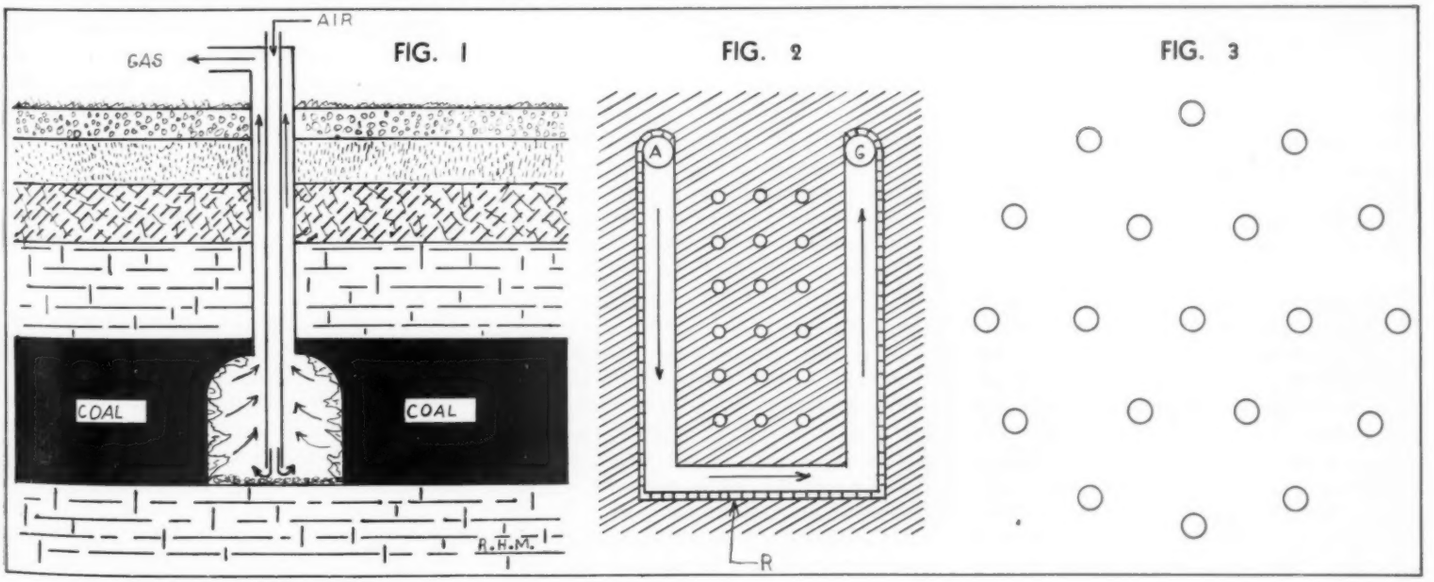
This commission had no lack of ideas of how to construct and operate an underground gas generator, but most of them turned out to be impracticable. The engineers entrusted with the project were familiar with above-ground gas generators, or what are known as gas producers, in which air is led through a column of lumpy coal and a burnable gas is taken out at the top. Their first operating model was to duplicate this arrangement underground. A passage was cut through the coal seam; the coal was loosened from one side of the passage and piled along the other side. When a sufficient amount of loose coal was accumulated, it was fired, and the products of combustion were drawn off at the surface. But this obviously did not do away with the labor, expense and danger of underground mining. Out of a great multiplicity of suggestions, the choice narrowed to two. One was the "potochki" or streamline method (Fig. 2), and the other was called the "filtration" method (Fig. 3).

In the "filtration" method, drill holes located on the perimeter of a circle would be sunk to the coal seam, with a similar hole in the center of the ring. A fire would be started in the central hole into which air is forced. The idea is that under this pressure, the hot products of combustion would be forced to seep, or filter, through cracks and fissures in the coal, (produced on occasion by shooting the bottoms of the holes with explosives) and escape through the outer holes. The advancing wave of hot gas would at first subject the coal to dry distillation, leaving the combustion to be supported by the residual coke; in this way a fairly rich producer gas would be obtained. When combustion reached the outer ring of holes, the center hole would be plugged, a ring of new outlet holes would be established further out, and the former gas-outlet holes would become air-input holes.

This filtration method has a certain attractiveness in that it completely dispenses with underground mine work, all holes being drilled from the surface. But it was found to have certain disadvantages, due chiefly to the difficulty of establishing the necessary permeability of the coal seam. Interest, therefore, became centered on the streamline method.

In the streamline method, two shafts a suitable distance apart are sunk to the bottom of the coal seam. From the bottoms of the holes parallel passages are driven out into the seam, and at convenient distance from the point of entry the two passages are connected by a crosscut. In the first experimental installations, the rectangular area thus marked out enclosed a large body of coal amounting to 30,000 and more tons. The outer sides of the two passages are walled off with a refractory lining to keep the fire within bounds. Kindling is piled for a short distance along the side of one of the passages and a fire

Fig. 1. Ramsey's idea of an underground generator; Fig. 2. Ground plan of a "streamline" underground gas generator. A—Air Shaft; G—Gas Shaft; R—Refractory lining. The small circles in the "peninsula" represent drill holes for inserting pyrometers in the coal seam; Fig. 3. Layout of drilled holes for underground gasification of coal by the "filtration" method. The coal is fired in the center hole where air is put in. Gas is taken from holes of the inner ring which later become input holes for a widening circle of gas-producing holes.



Checking on progress of the mine fire at Gorgas, Ala., with instruments and a peep-hole in the explosion head. U.S. Bureau of Mines photograph.

is started. Air is forced through one of the vertical passages, and the products of combustion escape by the other shaft. After cleaning and purification the gas is cooled and delivered to a pipeline. To give the operators information on the progress of the operation, small holes distributed over the enclosed area are sunk to the seam to receive pyrometers for measuring temperature. By this means the location of the burning face of the seam is indicated.

Up to the beginning of World War II, the Russians had several large-scale experimental installations of the streamline process in operation, the most important of which are located at Lichikansky and Gorlovsky. The coal seams involved are at no great depth and in some cases are too thin (less than three feet) and too poor in quality to be considered good mine properties in the ordinary sense. Particularly interesting is the works exploiting a coal seam in the Lower Moscow Basin which carries an inferior coal with 30 percent and more ash.

The Russian technologists in charge of the project are satisfied that the problem of underground gasification of coal has been solved. At least they have produced a burnable gas in quantity sufficient to operate steam boilers in neighboring factories. However, it is difficult to translate their production and cost data into terms of Western economics. The real value of the Russian ruble and the cost and productiveness of Russian labor are hardly measurable in units of non-Russian equivalents. But their figures appear to show that a million calories in the form of their gas produced underground costs substantially less (in Russian units) than the calories delivered at the surface in solid coal produced by labor.

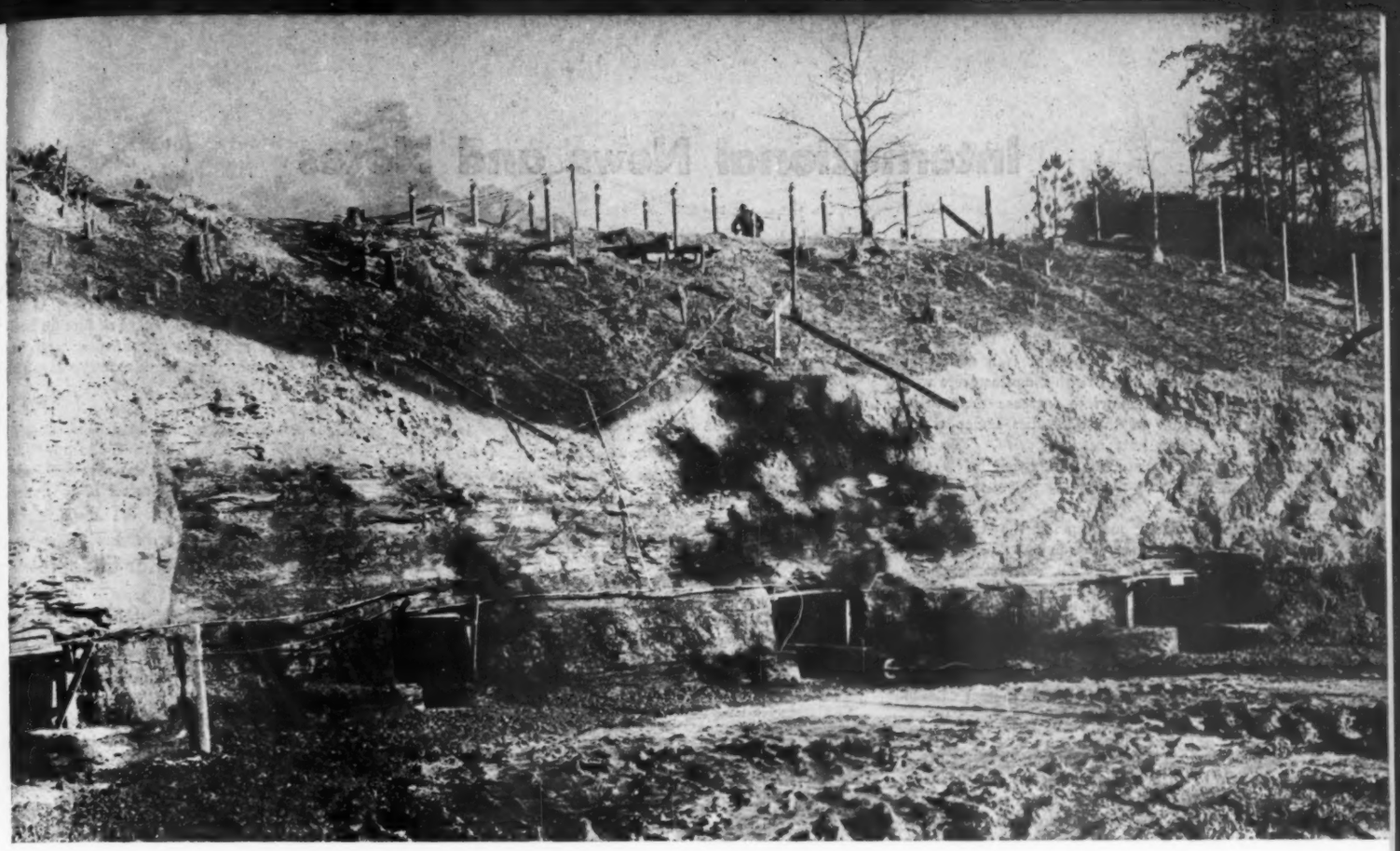
In the course of their experimental development of the underground gasification of coal, the Russian technologists have established certain leading points to be observed. One is that the overburden should be thick enough, or tight enough, to contain the injected air, which is delivered at pressures of one or two atmospheres, the higher the better with due regard to the economics of air compression. If the overburden is not right, there will be uncontrollable leaks.

The coal seam must be kept free from infiltrating water, which under certain circumstances many put out the fire, or, what is nearly as bad, will consume so much heat in its evaporation that the temperature of the process will not be high enough for effective dry distillation of the coal. The whole point of the process when using an air-draft is to burn a part of the coal to produce heat enough to drive off the volatile matter of the coal. An excess of water would interfere.

Another point when using a simple air draft is to manage the process so as to limit the combustion of the coke as much as possible to the production of carbon monoxide (CO) which is burnable, and prevent the formation of carbon dioxide (CO_2) which is not burnable. This limitation is difficult to bring about. It is, therefore, necessary to see that the seam of coal is well drained. The underground gas generators are preferably located where the strata are more or less inclined, though there are no indications to show that flat seams cannot be exploited, if dry.

The difficulty of limiting the production of carbon dioxide with an air draft is such that preference is given to a form of the well-known water-gas process. In this phase of the streamline process, air is blown into one of the shafts until the whole exposed face of the coal seam is actively burning, and then steam is blown through the other shaft in the reverse direction. The action of the steam draft produces a regular water gas of good quality, while the gas produced by the air draft is of low quality. For the production of gas of the highest quality, the Russians found it advisable to mix oxygen with the steam, which increases the temperature of the reaction and assists in producing a gas with the desired proportion of carbon monoxide and hydrogen. However, at last accounts the existing installations had not been provided with facilities for obtaining industrial oxygen.

It was expected that difficulty would arise from the reaction of the rocks lying near over the coal to the intense heat developed in the combustion process. As the coal burns, the roof of the seam will collapse and might block the passage of air, thus smothering the fire, especially if the rocks were fusible and produced a liquid slag that would flow over the exposed face of the coal. However, no material difficulty arose from this source. Lime rock and sandstones spalled



Observation holes at base of ledge of the 900-ton block of coal isolated for underground gasification at Gorgas, Ala. Holes were drilled from the surface and pipes inserted to contain gas sampling and temperature recording instruments. U. S. Bureau of Mines photograph.

under the influence of the heat but did not fuse, and the fallen derbis remained permeable to the steam or air. Shaley rocks tend to become plastic and sag and sometimes produce a fusible slag, but not to an extent that seriously interferes.

The first experimental project on the underground gasification of coal in the United States was started shortly after the close of the late war by the Alabama Power Company in collaboration with the Bureau of Mines at the company's Gorgas mine in Alabama. Alabama as a coal state is classed as a high-cost area; its seams are thin or have many partings of non-combustible material which require costly methods of cleaning and preparation, and under these circumstances it appeared highly desirable to test the possibility of recovering the heat values of this inferior material by an apparently convenient and inexpensive process. The experiment was fitted on what is known as the Pratt seam, which is horizontal, 30 inches thick, with an overburden of 30 feet. The design of the experiment followed the lines of the above-described Russian streamline method. Two six-foot shafts, 210 feet apart, were sunk to the coal, and from the bottoms of these shafts parallel horizontal shafts were driven 550 feet and connected by a crosscut. The "peninsula" thus marked out had an area of 115,500 square feet (2.67 acres) and contained approximately 15,000 tons of coal.

According to Milton H. Fies, manager of the Alabama Power Company's coal operations, (see Quarterly Bulletin, Interstate Oil Compact Commission, April 1947,) the experiment was marked by a number of adverse circumstances. Leaks occurred through the shallow overburden which limited the air input to 1450 cubic feet per minute under 1.5 psi, and hence the desired temperature of the process was not reached. Blower trouble caused shutdowns, and when the experiment was discontinued, not more than 300 tons of coal had been burned. Nonetheless, the experiment has yielded positive results. On account of the low temperature combustion due to the above-mentioned circumstances, the gas produced during the air blasting had a heat value of 50 to 100 Btu, but during the steam blast with a limited supply of oxygen gas the heat value of the "make" gas was from 150 to 221 Btu. When the experiment was inspected after cooling, it was found that at every point the coal had burned out clean, with very little coke, and the ashes were down on the bottom. The top of the coal seam burned faster than the bottom, but the face of the coal was at an angle of 60°. The roof was somewhat fusible, but it was not observed that this fact nor the complete collapse of the roof had materially interfered with the passage of the blast.

The Bureau of Mines and the coal company, while not discounting the problems still remaining, regard the work thus far as a successful experiment, and plans are being made to repeat the work on a larger area (40 to 60 acres) with a minimum cover of 120 to 150 feet and a blower capacity for a continuous pressure of not less than three atmospheres. This Alabama experiment was isited by numerous experts, including oil technologists who think the project may well developed into a source of synthesis gas for the production of synthetic gasoline by the Fischer-Tropsch reaction.

However, the immediate interest of the coal people is centered mainly on the possibility of improving the competitive position of coal as an industrial fuel. They have an eye not only on power production by steam raised at the mine site but also on the gas turbine, which has now arrived at an impressive stage of development and has proved itself as a prime mover that is as economical as any of its competitors. A high-temperature gas drawn from the mine would make a gas turbine located at the mine mouth a low-cost power-producer without boilers, condensers or stokers and other costly accessories. This might go a long way toward the German example of generating most of the nation's electric power at the mine mouth, especially in highly populated regions not too far from coal-producing regions. Besides that, there is the possibility of delivering a good quality of water gas to existing or specially built pipelines for domestic consumption or for chemical synthesis.

The Alabama experiment was aimed mainly at obtaining confirmation of Russian experience regarding the fundamental operation factors. Little or no attempt was made to establish cost data, but this will come later.

International News and Notes

Equipment Manufacturers Review Progress of Past Year

Export sales of oil equipment from the United Kingdom totaled $80,000,000 in the first half of 1947. In all of 1946 sales totaled $134,000,000. The increase this year at the rate of 19 percent is a matter of considerable satisfaction to British manufacturers who are making a special effort to increase their sales, particularly in view of the difficulties under which they worked during part of the period. The fuel shortage undoubtedly reduced production below that which might have been attained.

At the recent annual meeting of the Council of British Manufacturers of Petroleum Equipment at which the sales figures were announced, the chairman reported on two outstanding accomplishments of the Council during the past year. One was the mission to the Caribbean of a group of members to study equipment needs of the oil industry in Latin America and Trinidad. The second was the publication of "British Petroleum Equipment," the first joint catalog of the British oil equipment industry.

A group of ten equipment engineers and executives made the trip to oil producing areas in the Caribbean late in 1946 to survey the possibilities of expanding oil equipment trade in Latin America and to determine what steps British manufacturers should take in order to increase their business in Latin America. On their return to England the group prepared a joint report of findings which was circulated among the 176 members of the Council. The mission was well received both by oil industry and government representatives in the various countries visited and returned with a great deal of enthusiasm over prospects of expanding trade.

Members of the mission asked for criticisms wherever they went. One of the most frequent of these was that the British had not supplied enough printed data about their equipment. To satisfy this want, the Council sponsored a composite catalog this spring. In it were announcements of the 176 member companies. The catalog was sent to oil equipment buyers in all parts of the world.

A new edition of the "British Petroleum Equipment" catalog will be published in 1948. The Council now is urging members to include a great deal more technical data in the new volume. The chairman suggested at the annual meeting that blueprints and details of weights, pressures, temperatures and the like be included in the new issue. The Council also is producing a quarterly magazine dealing wtih British-made equipment.

The Council is considering the establishment of a permanent representative for British equipment manufacturers in the Caribbean. A committee has worked out a plan which will be submitted to members shortly. Standardization of equipment and of packaging for shipment overseas is being studied actively. The B.S.I. packaging code is to be modified with the aid of oil industry experts.

Mr. S. T. Robson, head of Wrightson & Co., Ltd., is chairman of the Council of British Manufacturers of Petroleum Equipment. Other officers are Niels Matheson, British Oilfield Equipment Co., Ltd., vice chairman; C. R. Sams, George Kent, Ltd., treasurer; and T. L. Bonstow, director and honorary member. The executive committee consists of the following: N. Birdseye, Braithwaite & Co., Ltd.; L. A. Callow, Stewarts & Lloyds, Ltd.; Maj. V. F. Gloag, M.C., Simon-Carves, Ltd.; Robert Gourlay, A. F. Craig & Co., Ltd.; T. C. Hunt, Metropolitan-Vickers Elec. Export Co., Ltd.; C. W. Knighton, Babcock & Wilcox, Ltd.; J. Mair, Glenfield and Kennedy, Ltd.; J. Martin, Whessoe, Ltd.; P. J. Sims, Associated Equipment Co., Ltd.; R. Wilson, Alley and MacLellan, Ltd.; and John Walsh, G. M. Marchant, Ltd.

Completes Forty-Year Service

Friedrich Gartner, managing director of Astra Romana S.A., Romanian subsidiary of the Royal Dutch Shell Group, celebrated the fortieth anniversary of his connection with the company in July last. Mr. Gartner entered the Bucharest office of Astra Romana in July, 1907, at the age of fifteen. He worked his way up through various departments and in 1920 was transferred to headquarters at The Hague, where he spent the following five years in the offices of the Bataafsche Petroleum Maatschappij. In 1925 he returned to Romania as manager of the refinery at Ploesti. Five years later he became commercial manager at Astra's main office in Bucharest and in 1940 was appointed general manager.

During the German occupation of Romania, Mr. Gartner had a difficult time. He was forced to surrender his position to a Nazi appointee but remained in Bucharest throughout the occupation though under constant Nazi surveillance. When the invaders were forced out, Mr. Gartner was restored to his former position by the Romanian government, and after contact was established with the owners of the property, he was made managing director.

Dr. Luigi G. Castelli

South American Representative

Dr. Luigi G. Castelli, prominent South American businessman and authority on petroleum refining has been named South American representative for Houdry Process Corp..

Dr. Castelli, a member of the Spanish and Italian nobility, began his studies at University of Naples where he received his engineering degree. He continued his studies at Sorbonne University, Paris, and finished post graduate work at the Institute of Physics and Chemistry.

The new Houdry representative, whose headquarters are in Buenos Aires, Argentina, has had extensive experience in the petroleum and industrial fields. He has been connected with the engineering department of the Public Service Corporation of New Jersey; he has served as consulting engineer in charge of foreign business for Seabrook Engineering Corporation; and has been general Latin-American representative for The Lummus Company.

He is owner of Etablicimientos Mecanicos Castelli rolling mills; vice president of the White and Blue Lloyd, shipping lines; consulting engineer for Indo, S. A., linseed oil plant; and a director of the Loleri Ship Yard.

Assembles Equipment for Ethiopia

A deep test rotary drilling unit, capable of drilling to a depth of in excess of 12,000 feet, has been assembled at seaboard by Sinclair Petroleum Co. and is ready for shipment to Ethiopia. In addition the company is also shipping a motorized rotary type water well drilling machine, together with two water well pumping units and water purification systems to provide water for drilling operations and field camp use in Ethiopia.

Approximately 23 different types of motor equipment, including automobiles, trucks, tractors and road graders are already en route to Ethiopia, together with a wireless telephone system which will be constructed for the purpose of maintaining communications between headquarters at Dire Dawa, the center of the company's field operations in Ethiopia. This system has a 500-mile radius.

Twenty-eight steel tropical-type insulated portable buildings for the housing of personnel and storage of material will be set up at field headquarters. In addition the company is shipping a portable stone crushing plant together with two concrete mixers for building roads, acetylene and electric welding equipment for use in field and shop operations, and complete camp equipment for field forces, including kitchens. Field forces will be equipped with walkie-talkie telephone, and a four-passenger Stinson airplane will be used for the purpose of transporting personnel and light equipment from warehouses to the field.

The company was granted a concession in July, 1945, covering the entire area of Ethiopia, about 350,000 square miles.

Extends Services in Venezuela

Axelson Manufacturing Co. is extending its sales and service organization in Venezuela and Colombia. C. A. Industries, Waldrip y Campbell, with headquarters at Caracas and branches at Barcelona and Maracaibo, Venezuela, will stock, distribute and service Axelson pumps, sucker rods and lathes. Pump shops will be maintained at both Maracaibo and Barcelona.

M. Ray Conger will be located at Caracas, Venezuela, as direct factory representative for Axelson. Mr. Conger has been with the company in sales and service activities since 1929.

British Oil Production

Production of crude petroleum in the United Kingdom during the year 1946 was 55,387 tons, approximately 388,000 barrels. This is the figure reported by Anglo-Iranian Oil Co., Ltd., the only company actively engaged in production in Great Britain.

Photo by courtesy of ARAMCO

Although seasoned drillers have pet names for it, the rich reservoirs of the Arabian Desert hold a golden promise for the oil world. It is here, too, that Patterson-Ballagh Drill Pipe Stabilizers and Casing Protectors are aiding drillers to tap those deep, dark reservoirs with less grief and greater speed.

The two Arab roughnecks shown above are working on a rig at Abqaiq for the Arabian American Oil Co. Also, you see here a Patterson-Ballagh Kelly sub Stabilizer at work. Note that the rat hole is made large enough in diameter to take the Stabilizer as well as the grief stem. This solid PBX rubber Stabilizer fits into a groove on the Kelly Saver sub and does a key job in protecting the entire drill string, surface casing, swivel and table from shock damage due to Kelly whip. It acts as a frictionless bearing for the Kelly, giving you smoother R.P.M.'s for making hole faster.

No matter where you are drilling, you will avoid the "grief" in your grief stem by installing a Patterson-Ballagh Kelly sub Stabilizer at the earliest opportunity. On pages 3068 to 3071 of your Composite Catalog you will find sizes specified for over 700 various Kelly sub set-ups in use today. Ask your Patterson-Ballagh man to help you in selecting the right size for your operation.

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OIL COMPANY STAFF CHANGES

E. D. Wallace

Richard W. French

E. D. WALLACE, vice president in charge of production for Standard Oil Co. of Ohio, has been elected a director to fill the vacancy caused by the recent resignation of S. A. Swensrud. Mr. Wallace came to Sohio in 1942 as manager of producing operations when the company's production was less than 1,000 barrels daily. In the five years since then production has increased to 26,000 barrels daily.

Before joining Sohio Mr. Wallace had had many years experience in oil and gas. He had become president of Peoples Gas Co. of Kentucky, within 11 years after graduation from the University of Kentucky. He served as director of Petroleum Exploration Co., Southern Petroleum Exploration Co. and the Wiser Oil Co. From 1934 to 1939 he was president of the Kentucky Oil & Gas Ass'n, and has been active in the Independent Petroleum Association of America and on wartime industry committees.

Mr. Wallace announced the appointment of Richard W. French as chief engineer for Sohio and as his immediate assistant in managing the growing production department. Mr. French comes to Sohio from Continental Oil Co. for which he began working in California fields as a roustabout in 1933. He later directed Continental's production engineering activities in California and in 1943 was made assistant manager of production and drilling for the entire company. Mr. French will have his headquarters in Oklahoma City.

Other new Sohio appointments include William H. Strickler as manager of the Michigan district; Cecil C. Irby as Kansas superintendent and John E. Buckley as Michigan superintendent.

W. NELSON AXE has recently been appointed supervisor of the lubricating oil research section for Phillips Petroleum Company. Receiving his Ph.D. degree from the University of Texas, Dr. Axe joined Phillips eight years ago. Immediately prior to his new work, Dr. Axe was in charge of patent work in Phillips research department.

RENE J. BENDER, who for the past 15 years was connected in an engineering capacity with the Sinclair Refining Company, has become assistant to the president of Sinclair Petroleum Company and will leave shortly for Addis Ababa, Ethiopia, where Sinclair is undertaking an exploratory campaign. "Chief" Bender was for ten years the editor of the Sinclair Firebox in Chicago. Upon his return from two years of service in the U. S. Navy overseas, he was attached to the home office. He contributed many technical papers on fuels to various engineering societies and technical magazines.

SPENCER S. PRENTISS has been appointed associate director in charge of patent affairs for the research department of Phillips Petroleum Company. Prior to his joining Phillips, Dr. Prentiss was engaged in governmental patent work in the Office of Scientific Research and Development.

CLARK S. TEITSWORTH has been elected to the board of directors of Socony-Vacuum Oil Company, Inc. As chairman of the manufacturing committee, he will continue to supervise all phases of the company's refining and research. Mr. Teitsworth joined the General Petroleum Corp., a Socony-Vacuum affiliate, as a chemical engineer in the process laboratories in 1926. He became a member of the manufacturing committee of Socony-Vacuum in 1935.

Clark S. Teitsworth

WILLIAM C. KINSOLVING has been elected president of the Sun Pipe Line Co. (Texas). He succeeds Jno. G. Pew, vice president in charge of production of the parent Sun Oil Company. F. Hill Sanders was elected vice president, general manager and a director, and Sanford E. Ogle, vice president and a director. Everett L. Meley is now superintendent of storage and delivery facilities of Sun Oil Company throughout the Southwest.

Mr. Kinsolving joined Sun as an oil field hand after receiving a degree in electrical engineering from Cornell University in 1923. He was placed in charge of the construction of a products pipeline in the East in 1930-31 and later the construction and operation of a crude pipeline from East Texas to the Gulf Coast.

During the war he was assistant director of transportation for the PAW, aiding in the planning and construction of the "Big Inch" pipeline. Subsequently he was commissioned a colonel in the army and helped build the China-Burma-India pipeline. Upon completion of his war service in India, Mr. Kinsolving returned to Sun as manager of all pipeline operations, and has also been elected president of the Susquehanna Pipe Line Company.

Mr. Sanders joined Sun Oil Company as pipe liner in the Vinton field, Louisiana, in 1932. During the war he served three and one-half years as a naval officer and held the rank of lieutenant commander when he left the service in October, 1945. Upon his return to Sun Pipe Line Company, he was appointed area superintendent of the Gulf Coast division.

H. F. MILLER head of the crude oil purchasing department of The Carter Oil Company, has been made a vice president. Mr. Miller has been with the company since 1921 and a director since 1933. He began work as an office boy in the New York office of Standard Oil Co. (N. J.) when 16 years old, and his service with Carter and other Jersey Standard affiliates has been continuous since 1902.

During this time he has been with American Oil Co., Ltd., of London, and Imperial Oil Co., Ltd., of Canada, as well as Standard and Carter. For more than ten years he served a former president of Standard Oil Co. (N. J.) as secretarial assistant and in those years made many trips abroad to the capitals and principal cities of Europe in addition to many visits to domestic companies in this country, Canada and Mexico.

H. F. Miller

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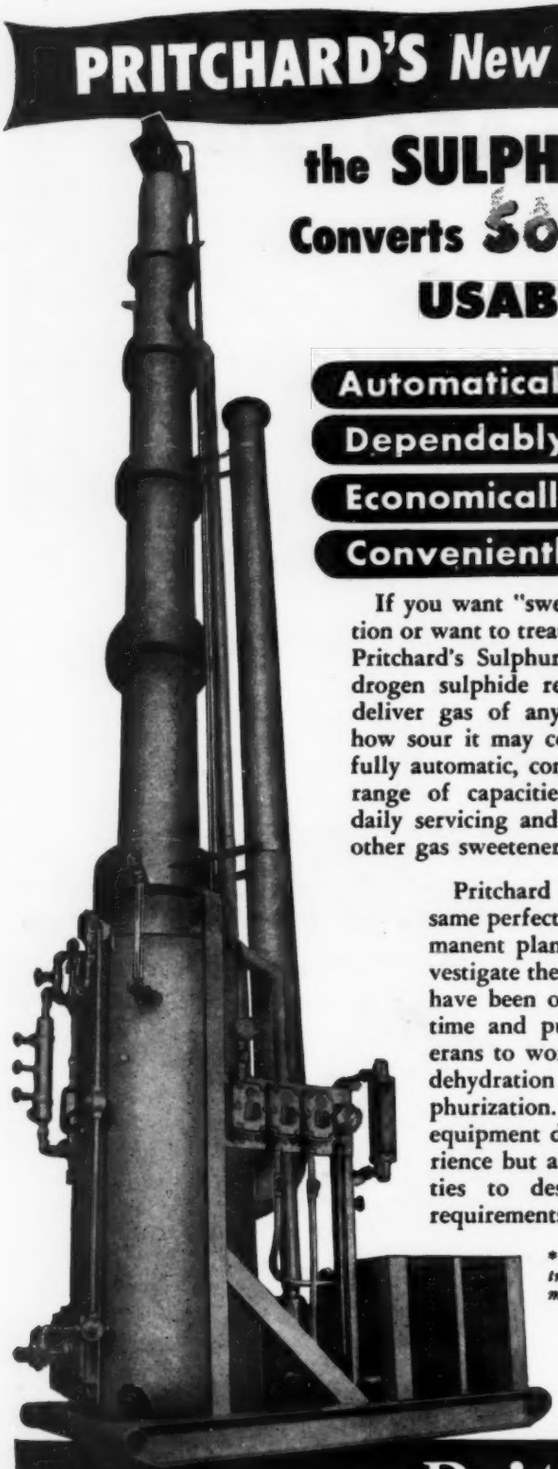

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Howard W. Page Jerry A. Cogan

HOWARD W. PAGE, head of the coordination and economics department of Standard Oil Company (N.J.) has been appointed executive assistant to Eugene Holman, president of the company. He succeeds Frank M. Surface, recently retired, who will continue to serve the company as a consultant. To head the coordination and economics department, the company announced the appointment of Jerry A. Cogan who has been assistant to Mr. Page.

Both Messrs. Page and Cogan were on leave of absence from 1942 until late in 1945 with the Petroleum Industry War Council and then with the Petroleum Administration for War. At the war's end, Mr. Page was director of the program division of PAW and Mr. Cogan was associate director.

Mr. Page was born in Berkeley, California, in 1906. He graduated from Stanford University and later received a master's degree in chemical engineering from Massachusetts Institute of Technology. He joined Humble Oil & Refining Company as a chemical engineer 18 years ago. In 1933 he served as a design engineer for Standard Oil Development Company and then spent most of the next six years as assistant manager of the European refining office of Jersey Standard.

In 1939 Mr. Page studied crude petroleum problems in Venezuela, Colombia and Texas and then returned to Europe as technical adviser on crude oil sales to non-affiliated companies. Returning to the United States after the fall of France, he became an engineering analyst for Jersey but continued to advise on crude sales until his entrance into government service.

Mr. Cogan was born in Canon City, Colorado, in 1910. He was graduated from Colorado College in 1930 and received his master of science degree from Massachusetts Institute of Technology two years later. Joining the Standard Oil Company of Louisiana in 1932, Mr. Cogan worked as a process engineer in the Baton Rouge refinery and then came to New York in 1934 to become a member of Jersey's coordination manufacturing group which was taken over by the coordination and economics department.

A. BRUCE BOEHM has been named manager of Paramins sales of the Enjay Company, Inc. He has been an employee of the Standard Oil Co. of N. J. or its affiliates since 1921, most of his work having been in the field of lubricating oil engineering and sales. Since 1941 he has been continuously active in marketing lubricant additives, now sold under the family brand name of Paramins.

Other changes in its sales staff announced by Enjay include appointment of Irving E. Lightbown as manager of rubber sales and W. V. Rathbone as manager of chemical and alcohol sales. Both previously were assistant managers of these divisions.

C F Braun & Company, proud of this Crude Stabilization and Pressure Maintenance Plant they constructed for Creole Petroleum Company at Jusepin, Venezuela, searched for the best and selected ELWOOD M. PAYNE to picture the completed job. Offices: New York, 475 Fifth Avenue; Houston, 4410 Roseneath Drive.

C. L. Henderson

C. L. Henderson, 56, president of Vickers Petroleum Co., died August 26 at Wichita, Kan. Mr. Henderson was a native of Tennessee and a graduate of the University of Tennessee in electrical and mechanical engineering. After several years with the Doherty utility interests he was elected vice president of Sterling Oil & Refining Co. at Witchita in 1917. He joined the Vickers company as vice president and general manager on Jan. 1, 1923 and succeeded to the presidency on the death of the late J. A. Vickers.

Mr. Henderson was president of the Western Petroleum Refiners Association from 1940 to 1946. He served on the PIWC during the war and the National Petroleum Council since then. He was a member of the API, ASTM and other industry organizations and committees.

CHARLES WILLIAM SUMAN recently left Los Angeles for Saudi Arabia to become an assistant petroleum engineer with the Arabian-American Oil Company. He expected to fly directly to Dhahran. Mr. Suman was an ensign in the United States Navy during World War II. For the past two months he has been making a study of petroleum engineering problems in the San Joaquin Valley. He is a son of George Suman, superintendent of production for Tide Water Associated Oil Co. in the San Joaquin Valley.

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James C. Martell

JAMES C. MARTELL, formerly civilian chief of the petroleum requirements section of the fuel division in Washington, D. C., has recently joined the staff of the Coastal Oil Co., Newark, New Jersey, as assistant to the president, Wiley H. Butler. Mr. Martell joined the Quincy Oil Co., Quincy, Mass., in 1927 and was superintendent of operations when he joined the Navy in 1943. Shortly before being ordered to inactive duty in December, 1946, he was requested to remain temporarily as civilian chief of the petroleum requirements section of the fuel division.

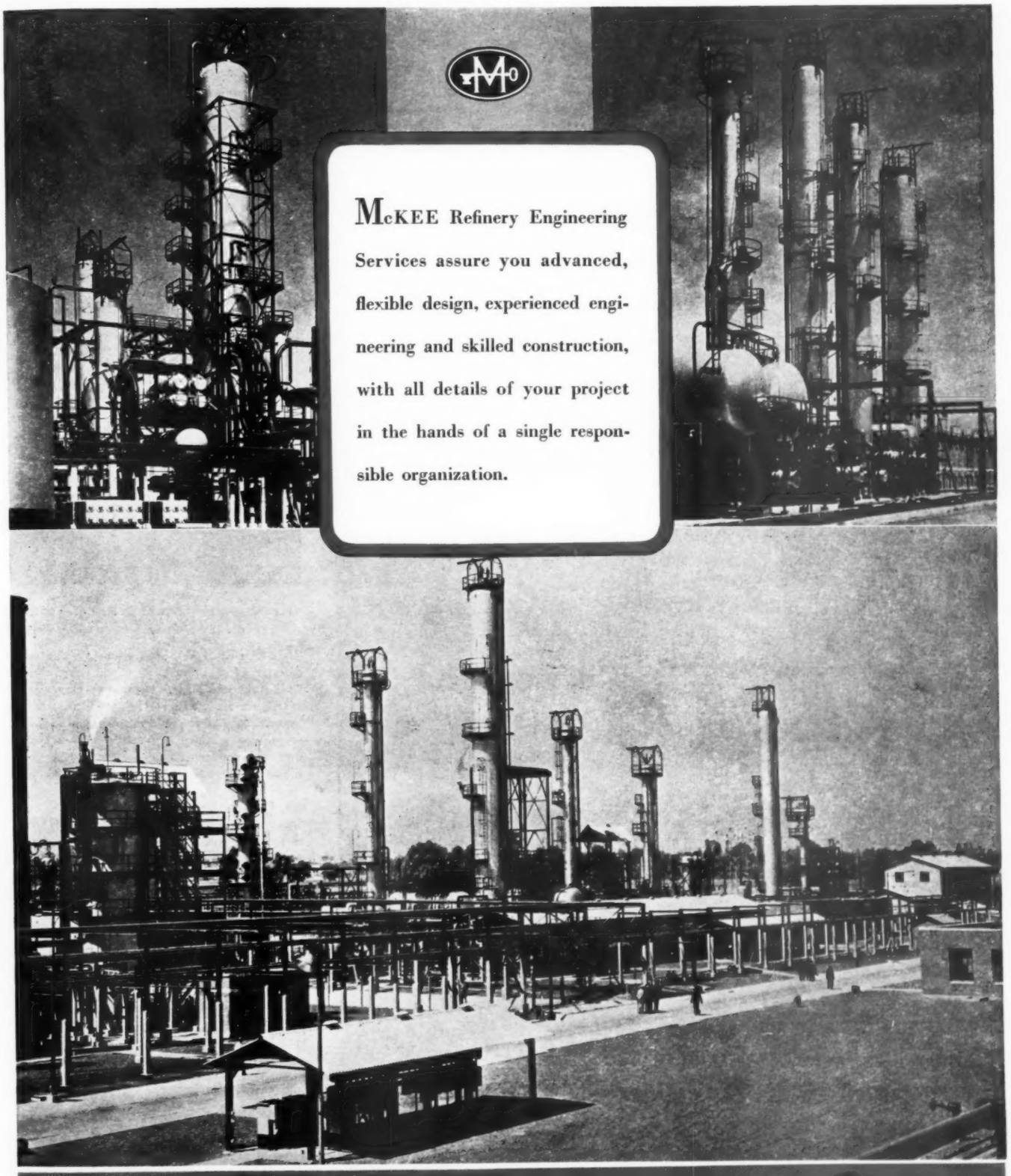
Addison Y. Gunter

Appointed Houston Manager

Addison Y. Gunter has been made southwestern district sales manager for the Alco products division of the American Locomotive Company. He will make his headquarters in Houston. Mr. Gunter has been with Alco since 1937 as production engineer, chief operations engineer, director of development and assistant manager of sales and engineering. Before joining Alco, Mr. Gunter served twelve years with Cities Service Oil Co. in Tulsa, Ponca City and East Chicago, where he was assistant manager of the refinery.

Roumanian Production

Complete figures for 1946 by all fields and companies show a grand total of 4,257,000 metric tons or 32,787,414 barrels.



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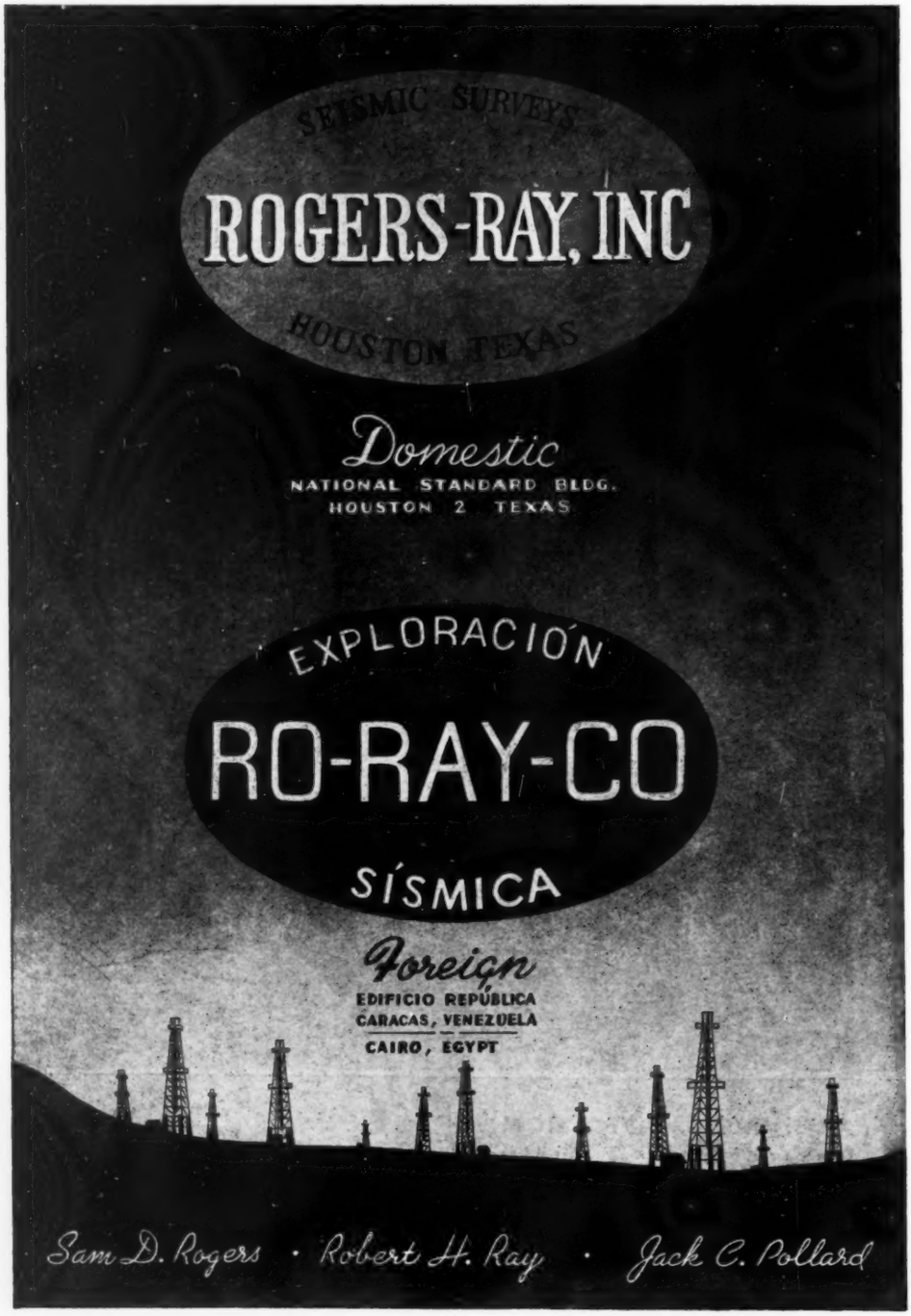
L. W. ELLIOTT, president of Standard-Vacuum Oil Co. has been made a brigadier general in the Officers Reserve Corps. He was a staff officer with General MacArthur in the last war and was one of nine colonels recommended for the promotion by President Truman. General Elliott is a veteran of both world wars. He was a private in 1917-18 and served some 16 months in France. At the time of Pearl Harbor, he was in the Netherlands East Indies as general manager of Standard-Vacuum Petroleum Mij., then known as N.K.P.M., producing and refining affiliate of Standard-Vacuum.

When the Japanese invaded South Sumatra, Elliott managed to escape to Java. But before he left, Dutch military forces destroyed the refinery at Soengei Gerong, near Palembang, in accordance with a prearranged plan. The decision to demolish the large, modern refinery was reached at the end of 24 hours of fighting with Jap paratroopers who dropped on the area.

In Java Elliott joined small United States forces serving under General Wavell and was commissioned a major. These troops retreated to Australia when Java was invaded, and when General MacArthur's Southwest Pacific command was established in 1942, Elliott was placed in charge of all petroleum supplies and construction of storage facilities. In recognition of his services he was elevated to the rank of colonel and received the Distinguished Service Medal.

After the Philippines campaign, Elliott returned to the States and was placed on inactive duty. He resumed work at the New York office of Standard-Vacuum and was named a director in May, 1945, and shortly afterwards, a vice president. On Sept. 10, 1946 when P. W. Parker succeeded G. S. Walden as chairman of the board, Elliott was named president.

Elliott began his career in the petroleum industry with Carter Oil Company in 1916 while attending Tulsa University. After broad exploration and refining experience in the United States and Mexico, he was sent to the East Indies in 1924 to construct the Talang Akar-Pendopo pipeline. In 1929 he was promoted to general manager of N.K.P.M.



J. L. Cooley

J. L. COOLEY has been elected vice president and director of California Research Corp., Standard of California subsidiary. He will be responsible for research on fuels and special products. At the same time changes were made in the responsibilities of two other vice presidents. W. N. Davis henceforth will supervise research on lubricating products, and L. P. Elliott will handle process research and engineering.

Mr. Cooley joined Standard in1920 in the engineering department at the Richmond refinery. He has served as technical assistant to the manager of research and development in San Francisco and as associate director of California Research Corp. In 1937 he was "loaned" to the Bahrein Petroleum Co. to organize its research and development department.

JOHN L. BIBLE has resigned as executive vice president of North American Geophysical Co. and has established offices as a consulting geophysicist specializing in gravity and magnetic supervision and interpretation and residual gravity computations and studies. He has joined with U. E. Neese and Fred A. Lauterbach in organizing Tidelands Exporation Company for performing precise gravity surveys on land and water. U. E. Neese was formerly in the geophysical and geological departments of Stanolind Oil and Gas Co. and recently with North American Geophysical Co. Fred A. Lauterbach was formerly in the geophysical department of Stanolind Oil and Gas Co. and during the past year supervised the gravity operations in the Gulf of Mexico for Robert H. Ray Co. The new offices are located at 2626 Westheimer, Houston 6, Texas.

WHITNEY WEINRICH, long experienced in petroleum research and development and prominent in affairs of the American Chemical Society, has joined the staff of the Houdry laboratories as head of pilot plant developments. Mr. Weinrich served as secretary of American Chemical Society's division of industrial and engineering chemistry from 1939 to 1943 and has done research work for Gulf Oil Corp. and Phillips

Whitney Weinrich

Petroleum Co. Last year he taught in Towne Scientific School, University of Pennsylvania.

In 1933 he entered the Gulf Oil Corporation's Philadelphia refinery as a petroleum technologist. When the chemical engineering group was organized by Gulf Research and Development Co., Mr. Weinrich headed that division, serving as assistant staff chemist for eight years.

During the war Mr. Weinrich became an important cog in PAW's government-industry war effort, particularly in the toluene and aromatics programs handled by the refining division of PAW at Washington. Upon leaving Washington, he joined Phillips Petroleum Co. as manager of the Bartlesville pilot plant section.

PHILIP S. FOGG, president of Consolidated Engineering Corp., Pasadena, Calif., has been selected as one of the group of five civilians which are to aid the Atomic Energy Commission in reconversion of atomic energy production from war to peace. Mr. Fogg will devote half his time to the commission and half to Consolidated, which manufactures mass spectrometers for the oil refining industry.

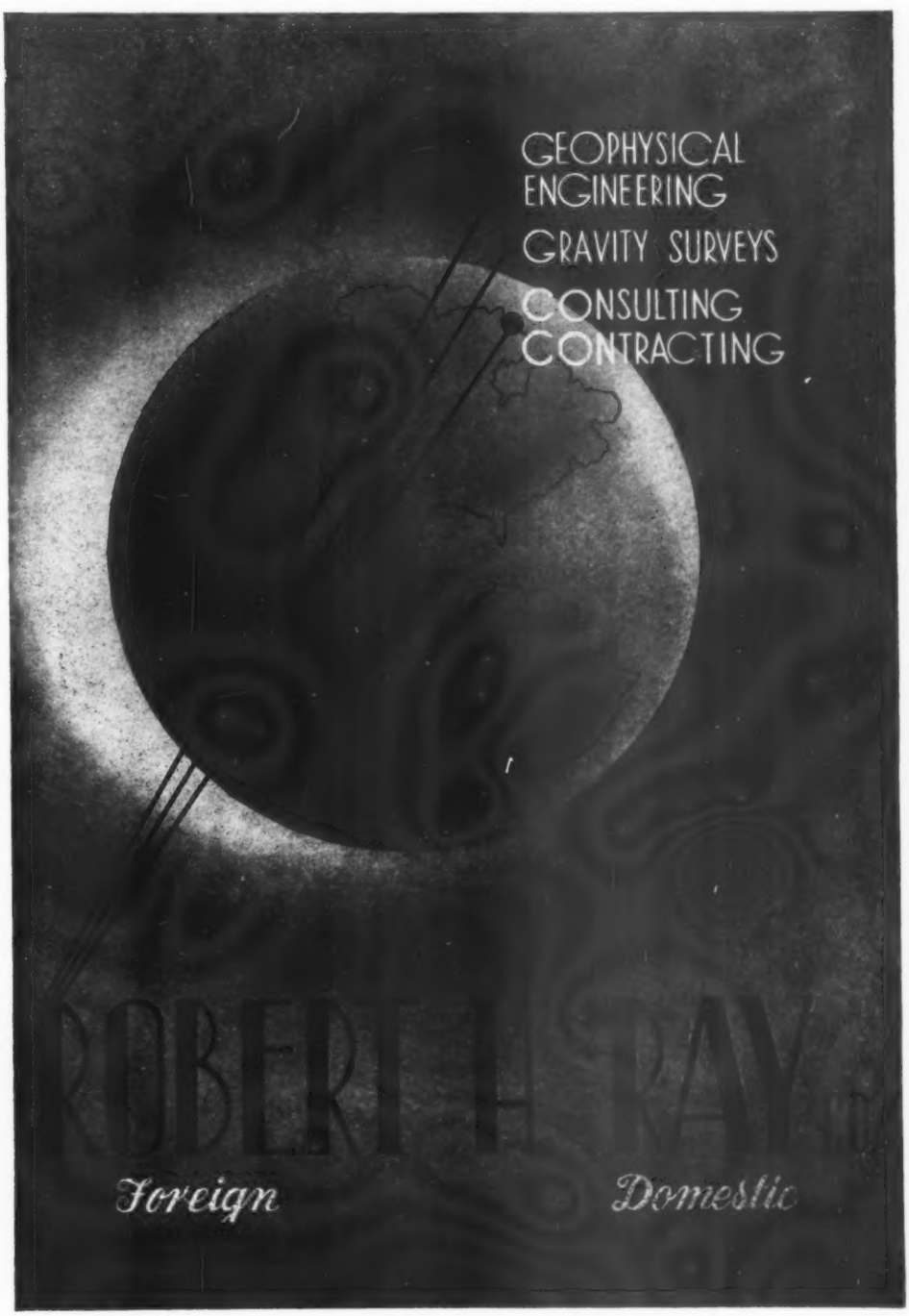
Dr. Louis Schmerling

DR. LOUIS SCHMERLING, a research chemist with Universal Oil Products Company, Chicago, has been selected as the first winner of the Ipatieff Prize, which was established several years ago by Professor V. N. Ipatieff, world famous chemist, and Mrs. Ipatieff. The $3,000 prize which is administered by the American Chemical Society, is to be awarded every three years for outstanding work in catalysis or high pressure by a chemist under 40 years of age. The recipient is selected by a jury appointed by the president of the American Chemical Society and will be presented at the ACS meeting in New York on September 15.

HARRIS T. DODGE has been appointed assistant to the vice president in charge of The Texas Company's foreign operations departments. Orin B. Small succeeds Mr. Dodge as general sales manager of Texaco's foreign sales department.

Mr. Dodge has been with Texas since 1920 in this country and abroad. He was made general manager, foreign operations sales, in 1943. Mr. Small was first employed in 1916 at Tampico, Mexico. In 1928 he was placed in charge of sales for the West Indies and Central America and in 1943 was appointed assistant general manager, foreign operations sales.

JOHN C. HALLIBURTON, who has served as vice president of Halliburton Oil Well Cementing Co. for the past thirteen years, has been elected president of the company. He succeeds his brother, Earle C. Halliburton, who becomes chairman of the board. The elder Halliburton founded the company and has been its executive head up to the present time. W. R. McClendon was reelected vice president, and L. D. Campbell becomes a vice president in addition to his duties as secretary and treasurer. The Halliburton organization was established at Duncan, Oklahoma, in 1919 and has since extended its operations not only to all oil-producing areas of the United States but also to six foreign countries.



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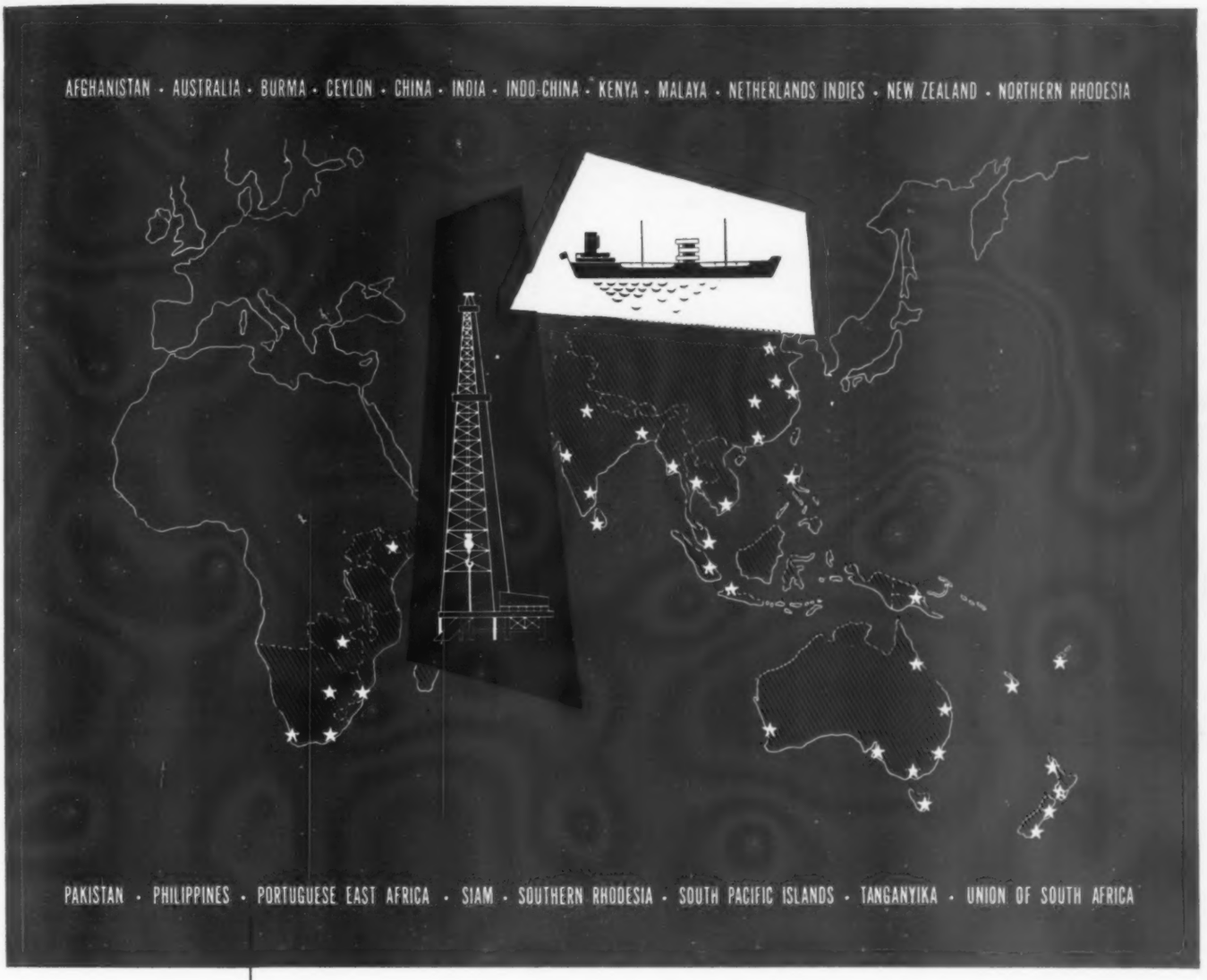
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Security Promotes "Pat" Robinson

L. G. "Pat" Robinson has been appointed assistant sales manager of Security Engineering Company, Inc. He has been California sales manager. Starting with the Company early in Security's history, "Pat" Robinson has been stationed in Illinois, Canada, the Mid-Continent, Gulf Coast and California.

Refrigeration for Field Use

Adding greatly to the comfort of oil industry workers, particularly in remote locations, and effecting substantial savings in perishable supplies are portable coolers and packaged refrigeration systems of which new models recently have been developed by Refrigeration Engineering Corporation, Philadelphia. The latest type of cooler is constructed on a hardwood framework instead of metal, is treated with waterproof and ratproof compound, insulated wtih fiberglas, sealed with a vaporproof barriers and clad with aluminum. They are impervious to attacks of the elements or of insect pests, can de disassembled, moved and reassembled without damage and are so light that any single panel can be lifted easily by two men.

This equipment in various sizes has been provided for oil company use in the Middle East, and recently the manufacturers received orders from Venezuela for a large block of plants for the fields there.

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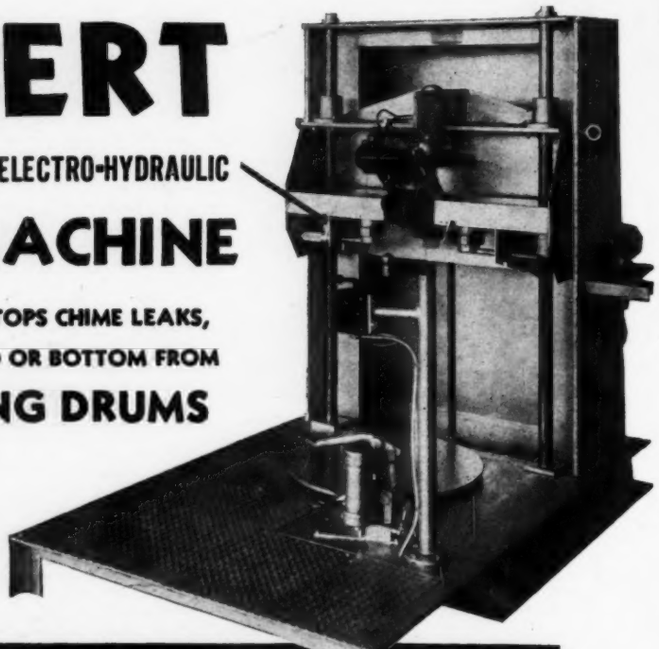

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B. V. Brown

B. V. Brown Moved to New York

B. V. Brown has been transferred to the New York City office, according to an announcement made by G. W. Walton, vice president of the machinery and export division, International Derrick and Equipment Company. Mr. Brown will handle sales of products that supplement the equipment manufactured by Ideco from the export office in the Chanin Building in New York. He was formerly manager of purchasing and stock control at Ideco supply stores in Dallas. He has been associated with oil field manufacturers and suppliers for the past twenty years in sales work and purchasing.

Oil Base Sales Appointments

Arthur K. Brown has been appointed to the Rocky Mountain sales staff of Oil Base, Inc., Los Angeles. His headquarters will be at Vernal, Utah. Ralph Ruse has been transferred from the Rocky Mountain district to West Texas where he will make headquarters at Odessa. Black Magic muds are warehoused at this point for West Texas.

Water in Oil Production

Petroleum Production, Vol. III: Oil Production by Water, by Park J. Jones; published 1947 by Reinhold Publishing Corp., New York; $5.00.

This third installment of the author's treatise on oil production is limited to production by water. It takes into consideration all conditions wherein oil is displaced by edge water, bottom water or injected—in general, displacement of oil by an advancing oil-water interface, regardless of the source of the water. The principal factors in production of oil by water are listed as convergence, fluid factors, invasion factors, displacement factors and well interference factors. The job of the production engineer is to "maximize" the joint effect of these factors in the most favorable economic sense. As there are about 100 possible trap-forming combinations of structure and stratigraphy, the situation may become rather complex in certain cases, calling for a statistical approach by which the capacities of a number of wells may be estimated in terms of one average well.

This 271-page book helpfully defines the fundamental principles and shows their practical applications. It should be in the hands of every oil production engineer, particularly those who are called upon to engineer projects of secondary recover by artificial water drive, an art which is now beginning to assume more and more importance.